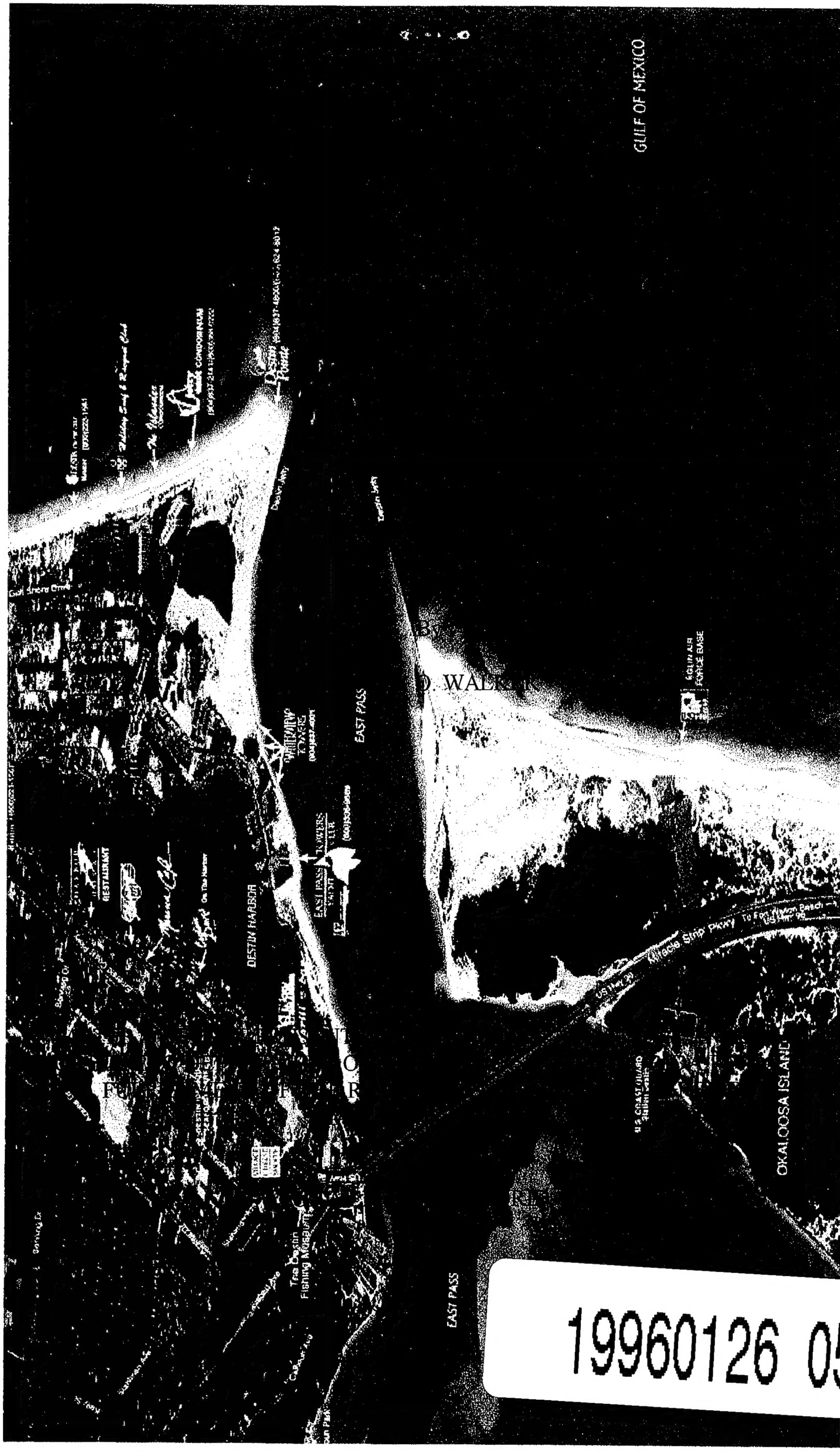

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1. REPORT IDENTIFYING INFORMATION		R[illegible] 1. 2. 3. 4. 5.
A. ORIGINATING AGENCY NAVAL POSTGRADUATE SCHOOL,MONTEREY,CA 93943		
B. REPORT TITLE AND/OR NUMBER A Master's report presented to the Coastal and Oceanographic Engineering Department		
C. MONITOR REPORT NUMBER WALKER, Wayne O. Thesis, University of Florida Dec 95		
D. PREPARED UNDER CONTRACT NUMBER N00123-89-G-0549		D 1. 2.
2. DISTRIBUTION STATEMENT APPROVED FOR PUBLIC RELEASE, DISTRIBUTION UNLIMITED		

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ACKNOWLEDGMENTS

I wish to express my deepest gratitude to my advisor and supervisory committee chairman Dr. D. Max Sheppard, for his support and guidance during my Master's research. I would also like to thank the members of my supervisory committee, Dr. Robert G. Dean for his support in establishing the Navy Program here at the University of Florida and Dr. Charles R. Glagola for his patience and keeping perspective even when I loose mine.

Without the help of all those around me, I could not have accomplished this program in 17 months. Special thanks go to Paul DeVine, and Marshall Bridges for staying up all those extra hours trying to breath life back into what little math was left in my head when I arrived. Also a special thanks to Mark Gosselin, always there to help with whatever problem, and gifted with an ability to teach, I wish you well in your career in academia. For countless answers to countless question dealing with computers, and continually trying to get me up to speed on various computer programs my deepest appreciation to Bill Miller, Chris Jette', and Eric Thosteson.

Thanks to everyone at the Coastal Engineering Lab, without their help this research never would have been possible. Vic, Chuck, Sidney, Vernon, Danny, J.J., and George, you inspire "operation duct-tape" daily. Thanks also to Becky, Sandra, Sonya, Lucy, and Laura for keeping me on track, and out of trouble.

Most of all, my deepest and most heartfelt love and appreciation to my dearest friend in the world, my wife Patricia. Lady, without you I would not be where I am today. Thanks for blessing me with a wonderful family, home, and life.

Thank you Lord for all your many blessings.

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LIST OF EQUIPMENT

Name	Equipment Description	Manufacturer
Camera	Fixed Video Camera	Deep Sea-Power & Light (MSC-1050 #010)
Mesotech	Acoustic depth sensor	Simrad Mesotech Model 810 2.25 MHz echosounder 3.2 degree beamwidth
Marsh-McBirney	Current sensor	Marsh-McBirney Model 585
Tattletale	Controller and data logger	Onset Tattletale IV Model IV - Data Logger
VCR	8mm Video Cassette Recorder	Sony Model EV-S550

Abstract of Master's Research Project presented to the Department of
Coastal and Oceanographic Engineering in partial fulfillment
of the Requirements for the
Degree of Master of Science.

FIELD MEASUREMENTS OF LOCAL PIER SCOUR IN A TIDAL INLET

By

Wayne O. Walker

December 1995

Chairman: D. Max Sheppard
Major Department: Coastal and Oceanographic Engineering

Present design criteria and existing scour prediction models were developed primarily from the study of steady, homogenous, unidirectional flow. These models have been extensively reviewed and fine tuned, and for the riverine environment provide a good basis for the design effort. However, tidal flows are not normally unidirectional. A multitude of hydrodynamic processes affect these inlets and cause the current to alternate and change directions. Wind, waves, storm surge, runoff, seich, and river discharge can affect the direction and velocity of the current, but the primary source of the alternating current is the astronomical tides.

This paper will examine local pier scour, and in particular look at scour that occurs under the unsteady, reversing flow condition at a tidal inlet. There is very little known about this cyclic scour process. Most of the local scour studies have been conducted in laboratory flumes under steady flow conditions. Due to the lack of complete field data

(i.e. experiments where all pertinent parameters are measured) it is impossible at this time to accurately relate laboratory results to prototype situations. This is true for steady flow as well as the more complex unsteady flow situations. In the meantime bridges and other structures must be designed using the best available information. Accurate, well documented field measurements thus provide much insight into the complex fluid dynamics and sediment transport processes that are involved in local sediment scour.

The primary focus of this report will be to develop the techniques and equipment needed to monitor and capture the scour processes on a prototype scale structure. Exactly what data is needed and how we capture this data in the actual field environment will be examined. In situ measurements of local scour in the field has proved to be very challenging. A study using video recordings, acoustic profilers, manual survey techniques, and other environmental data collection equipment was conducted at the East Pass bridge in Destin Florida. The results of this 10 day field experiment are presented with comments on the findings and procedures used. In addition to the lessons learned, comments and suggestions for future work are provided.

CHAPTER 1

INTRODUCTION

Scour processes, particularly the scour processes that control local structure-induced scour due to steady, unidirectional flow are well defined and documented. Numerous laboratory investigations on simple piles in steady flows have been conducted. A substantial number of field measurement have also been made over the years. However, in the case of field measurements few data sets, if any are complete in that one or more of the key variables were not measured. This lack of complete, high quality field data has made it difficult for researchers to relate laboratory results to prototype situations, even for simple structures in steady flows. For unsteady flows the scour processes are even more complex and quality laboratory or field data are almost nonexistent.

Tidal inlets exhibit an alternating flow with the movement of water caused by the astronomical tides and other geophysical forces. Bridges and other structures placed in this alternating current are designed using the riverine, steady, unidirectional flow models. The scour predicted by the riverine equations and models appears to over predict the depth of scour in tidal situations. Though much work has been done in the laboratory to develop constant flow models, little has been done on the alternating current model, or on the cyclic scour caused by this alternating current. There is a definite need for both

laboratory and field measurements in unsteady (reversing) flows. Laboratory data provides insight into the processes and helps quantify the relationships between variables. There can, however, be problems associated with scale (e.g. in almost all laboratory test prototype sediment is used) and thus the need for good field experiments.

This project was fielded with the realization that there is little documentation regarding structure-induced scour in tidal inlets, and that there is a significant need for accurate data in the tidal inlet environment. The goal of the project was to develop the equipment and procedures necessary to capture the scour process as it occurs in the tidal inlet. Several concepts were to be tested, such as time lapse video, and acoustic profiling. In addition the concept of filling an existing scour hole and observing the reformation of the hole would be reviewed.

The plan consisted of placing an instrument package on an existing pile, with a known scour condition, filling the existing scour hole, and then monitoring the scour through a spring tide cycle. The package consisted of a video camera, for time lapse video monitoring of the scour hole, two underwater lights for night time operation, a Mesotech transponder for measuring the scour hole depth at a point and an electromagnetic current meter. The original plan called for two electromagnetic current meters to monitor the current but due to limited resources only one meter was used. The instrument package was mounted to the pile using aluminum angle and all-thread to create a large clamp to attach the underwater framework. By mounting in this manner a stable, non-invasive platform was obtained.

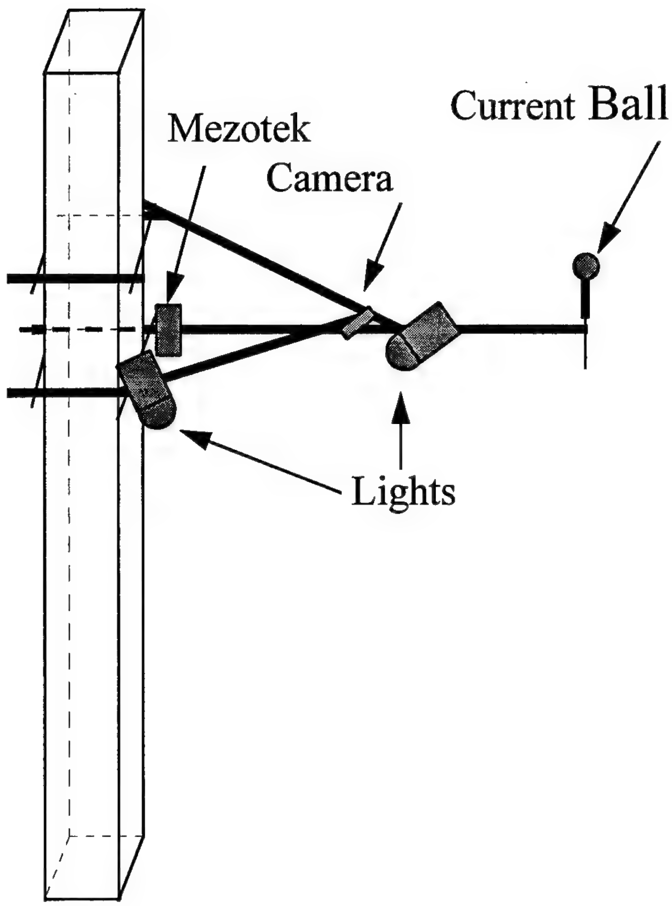


Figure 1.1 Schematic Diagram of Equipment Layout

The instrument package was mounted and all leads for power and data transmission were led up the pile to the catwalk that was attached to the bridge deck. The recording package consisted of a Tattletale IV controller with a portable PC interface, and a Sony Super 8 VCR. A character generator was added in-line to the video equipment to place a time-date stamp on all video taken. The power was supplied for all the equipment by two 12 volt deep cycle batteries and a 250 watt inverter. The recording equipment was mounted in a weather tight box. The recording equipment box was made of aluminum

with a weather tight gasketed lid. The entire box was painted white and a sunshade constructed of 1/2 inch plywood that was mounted with 3 inch standoffs to the lid. The white box and associated sunshade allowed the equipment to operate at ambient temperature with no heat build-up from the sun. The package performed without a flaw even with ambient temperatures reaching 103°F during the day. The recording package and battery box were mounted to a frame which was attached outboard of the safety rail which ran along the bridge. See Figure 1.2

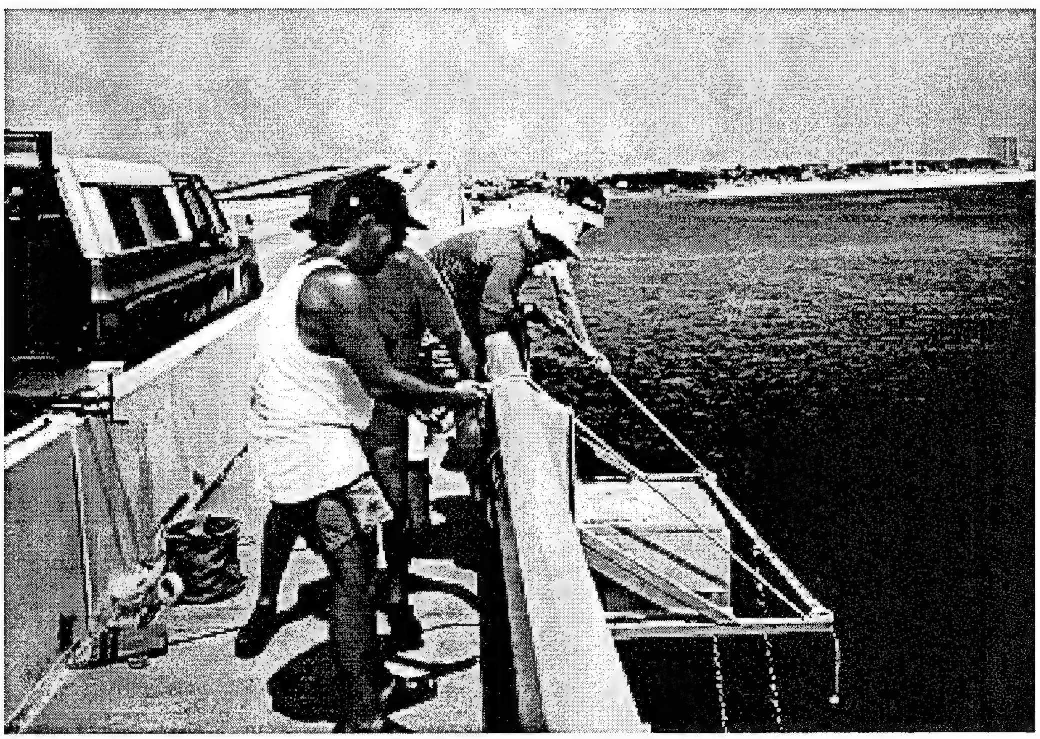


Figure 1.2 Attaching the Equipment Frame and Battery Box to the Bridge Structure

The East Pass Bridge, Destin Florida was selected as the test sight for several reasons. First it offered a protected location that was easily accessible. The visibility is normally

outstanding, particularly during the incoming tides with the inrush of clear gulf water. The bottom consists of a well graded white, sand with a D_{50} of .28 mm at the site. In addition there was a wide range of scour holes to choose from for the test. This variety was the result of the various depths and currents available due to the geometry of the pass.

In addition to the electronic surveillance, it was planned to conduct manual surveys to provide the base line for the equipment calibration as well as a known reference with which to compare the data. During these survey dives many of the specific scour processes were observed and captured with hand held video. The results of these observations will be discussed later in this report.

Though originally designed as an equipment/procedure proof-of-concept research project, a credible data set for an eight day period was obtained. Bottom bathymetry in the area of the pile was documented on a regular schedule of two surveys a day along with the collection of current speed and direction. These data are presented in conjunction with the report on the equipment and the data collection processes used.

CHAPTER 2

EQUIPMENT DEVELOPMENT

Before going into detail on the actual equipment development, a brief review of tidal inlet processes and current methods and design criteria for scour analysis in tidal areas might be in order.

Tidal Inlet Processes

It is assumed that the reader has a general understanding of the littoral zone and coastal processes. As such this will be but an overview of the key elements that combine to effect the pile scour in the tidal inlet. Should more detail on these subjects be required the reader is directed to Dean (1991), Duxbury (1984), and Sorensen (1978).

As stated earlier the primary cause of the alternating current in tidal inlets or other coastal regions are the astronomical tides. This is, however, not the only mechanism that influences the current direction, or speed. Other key factors include meteorological tides, wind , seiching, and river and storm water runoff.

Astronomical Tides

These tides are the rise and fall of the surface water level due to gravitational and centrifugal forces interacting between the earth's oceans and celestial bodies including our moon, sun, and other planets and stars throughout the universe. By far the largest effect is due to the moon's gravitational influence. These gravity related tides are

manifested in long waves which result in diurnal (once a day) or semi-diurnal (twice a day) highs and lows. As long waves "they are affected by Coriolis accelerations, shoaling, refraction, diffraction, bottom friction, interaction between different tidal frequencies and resonance".

Meteorological Tides

Generally speaking these tides or fluctuations in the sea surface elevation and are due to prolonged meteorological events such as hurricanes or prolonged storms. The wind effects a mass transport of water. The net transport of water due to wind though is approximately at right angles to the sea surface wind direction in deep water. This phenomenon known as Ekman transport is explained in great detail in Duxbury (1984). In the northern hemisphere this transport is to the right, and in the southern hemisphere it is to the left of the wind direction. Should this movement of water meet with a barrier such as a coastline, the water will build and generate significant, often highly destructive tides.

Wind and Wind Waves

Wind blowing over water for a long enough time and long enough distance can generate significant sea surface waves. These waves upon reaching shallow water can effect a significant mass transport of their own. A tremendous amount of energy is imparted to the ocean surface through the wind . These wind generated waves can effect the scour process not only from a current or flow due to setup but also from wave induced scour. Even though wave induced local scour can be significant it is in general less than that induced by steady currents. It will not be addressed in this report. The

wind and wind waves are addressed here primarily to account for their effect on water flow or mass transport and the resultant wind driven current's effect on local pier scour. The clearest example of these wind driven, wave supported currents would be the longshore current which is generated from waves impinging on the beach at an angle.

Seich

Easiest to picture as the sloshing of liquid in a closed container such as a cup of coffee or bowl of water. On a larger scale this "sloshing" effect is felt in closed or semi-enclosed bodies of water such as the Gulf of Mexico, or the Great Lakes if excited in some fashion, such as by earthquake motion, impulsive winds, or other effects.

Storm or River Runoff

If the tidal inlet opens into a large bay or enclosed body of water then the water entering the basin from other then the ocean can have a significant effect on the current experienced in the tidal inlet. Large amounts of water entering the bay from either rivers or storm water runoff from adjacent land areas can cause a significant increase in the water level. This in turn creates a greater current and resultant scour.

All these factors combine with local geography, bottom and sediment make-up, salinity, density, temperature, time of event, etc., to create an environment that is constantly changing yet requiring accurate prediction as to current flow direction, speed and duration. It is easy to see just from the above why empirical equations derived from laboratory experiments on constant speed, unidirectional flumes leave some room for error in an alternating, cyclic, tidal inlet design problem.

Types of Scour

In bridge design in the United States, the “bible” for the designer is Hydraulic Engineering Circular No. 18 or HEC-18, from the US Department of Transportation, Federal Highway Administration. The HEC-18 presents the latest information and design criteria for bridges as it relates to scour at bridge piers. Much of the following information is taken directly from the HEC-18. Where possible credit for individual data is presented.

Scour is the result of the erosive action of flowing water, excavating and carrying away material from the bed and banks of streams. Loose granular soils are rapidly eroded by flowing water, while cohesive or cemented soils are more scour resistant. The sediment scour that occurs near bridges is usually divided into three main categories according to the mechanisms that cause the scour. These are classified as:

1. Long-term aggradation or degradation
2. Contraction scour
3. Local scour

The HEC-18 explains these components in this manner:

Aggradation and Degradation

“These are long-term streambed elevation changes due to natural or man-induced causes which can affect the reach of the river on which the bridge is located. Aggradation involves the deposition of material eroded from the channel or watershed upstream of the bridge, whereas degradation involves the lowering of the bed of a stream due to a deficit in sediment supply from upstream. In the case of a tidal inlet, tidal ebb and flood may degrade a coastal stream, whereas littoral drift may result in aggradation of a stream.”

Contraction Scour

"Contraction scour occurs when the flow area of a stream at flood stage is reduced, either by a natural contraction or by a bridge. From continuity, a decrease in flow area results in an increase in average velocity and bed shear stress through the contraction. Hence, there is an increase in erosive forces in the contraction and more bed material is removed from the contracted reach, and than is transported into the reach. This increase in transport of bed material from the reach lowers the natural bed elevation. As the bed elevation is lowered, the flow area increases and, in the riverine situation, the velocity and shear stress decrease until relative equilibrium is reached; i.e., the quantity of bed material that is transported into the reach is equal to that removed from the reach. In coastal streams which are affected by tides, as the cross-section area increases the discharge from the ocean may increase and thus the velocity and shear stress may not decrease. Consequently, relative equilibrium may not be reached. Thus, at tidal inlets which experience clear-water or live-bed scour, contraction scour may result in a continual lowering of the bed (long-term degradation)."

Local Scour

"The basic mechanism causing local scour at piers or abutments is the formation of vortices (known as the horseshoe vortex) at their base (See Figure 2.1). The horseshoe vortex results from the pileup of water on the upstream surface of the obstruction and subsequent acceleration of the flow around the nose of the pier or embankment. The action of the vortex removes bed material from around the base of the obstruction. The transport rate of sediment away from the base region is greater than the transport rate into

the region, and, consequently, a scour hole develops. As the depth of scour increases, the strength of the horseshoe vortex is reduced, thereby reducing the transport rate from the base region. Eventually, for live-bed local scour, equilibrium is reestablished and scouring ceases. For clear-water scour, scouring ceases when the shear stress caused by the horseshoe vortex equals the critical shear stress of the sediment particles at the bottom of the scour hole. In addition to the horseshoe vortex around the base of a pier, there are vertical vortices downstream of the pier, the wake vortex (Figure 1). Both the horseshoe and wake vortices remove material from the pier base region. However, the intensity of wake vortices diminishes rapidly as the distance downstream of the pier increases. Therefore, immediately downstream of a long pier there is often deposition of material.

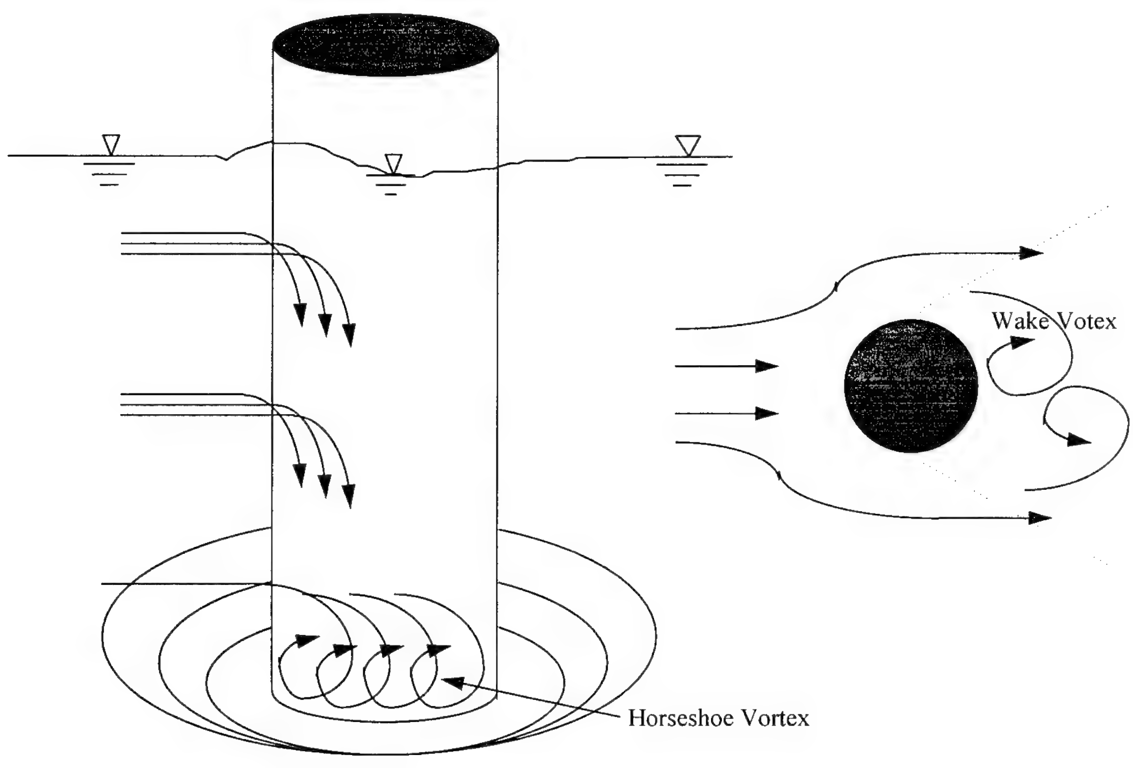


Figure 2.1 Schematic Representation of Scour at a Cylindrical Pier

Factors which affect the magnitude of local scour at piers and abutments are:

1) width of the pier
2) discharge intercepted by the abutment and returned to the main channel at the abutment
3) length of the pier if skewed to flow
4) depth of flow
5) velocity of the approach flow
6) Size and gradation of bed material
7) Angle of attack of the approach flow to a pier abutment
8) Shape of a pier or abutment
9) Bed configuration
10) Ice formation or jams
11) debris"

This area of local scour is one of the areas of great interest in tidal inlet scour situations. One of the big unknowns is the rate at which scour occurs. Combine this with an alternating current and it becomes extremely difficult to model. The success to date has been with empirical equations and data from relatively small scale laboratory studies. Little is known about local scour in cyclic currents. This is an area where much work is needed.

Current methods and design criteria

At this time the standard process for scour analysis in tidal areas consist of a three step approach. "Level 1 includes a qualitative evaluation of the stability of the inlet or estuary, estimating the magnitude of the tides, storm surges, and flow in the tidal waterway, and attempting to determine whether the hydraulic analysis depends on tidal or river conditions or both." If the water flow in and out of the inlet or estuary is based solely on the tides and runoff from rivers or watersheds have little effect on the flow then tidal analysis is appropriate. If on the other hand rivers flowing into the bay or tidal inlet are large compared to the tides then the evaluation can be performed using the techniques prescribed for standard riverine applications.

"Level 2 represents the engineering analysis necessary to obtain the velocity, depths, and discharge for tidal waterways to be used in determining long-term aggradation, degradation, contraction scour and local scour." The hydraulic variables obtained from the Level 2 analysis are used in the standard riverine equations and applications. It is assumed that using these equations which are based on steady state equilibrium conditions for unsteady, dynamic tidal flow will "usually result in estimating deeper scour depths than will actually occur (conservative estimate)." These assumptions and methods represent the state of the art at this time. A recent article in Civil Engineering magazine drives home the point of just how "good" our state of the art really is. In the June 95 issue an article on scour states "more then 85,000 bridges in the U.S. are vulnerable to scour, and foundation conditions for another 104,000 cannot be determined". Many of these bridges exist in areas affected by tidal influences.

Level 3 analysis involves the use of physical models or more sophisticated computer models for complex situations where level 2 techniques could prove inadequate. In general a level 3 analysis will require the help of highly specialized hydraulic engineers.

Data Collection Concepts

With the above review in mind, and remembering that the focus of this project was to develop the tools and techniques to monitor the scour process, the following areas were targeted for study and data capture: maximum depth of scour, volumetric rate of scour, and mechanics of the cyclic scour process.

To monitor the maximum depth of scour, a Mezotek depth sounder was utilized. It was to be mounted in a manner that would measure the distance to the bed adjacent to the

pile. This device was used because of it's accuracy, not only in measuring depth, but for it's narrow beam. The test here would be to measure performance in the field environment, and evaluate it's potential for use in future projects, possibly on a moving framework to enable it to become a true bottom profiler.

The difficult part here was to develop a method to check the accuracy, while attempting to utilize the Mesotech to monitor the scour development. By taking numerous samples, and comparing them with measured depths, the accuracy could be determined. The measured bottom profiles and depths were determined in two manners; 1) manual surveys, and 2) video recording.

As with any baseline study, the manual survey was the most time consuming, and yet produced the fewest number of data points. However, through post-processing the survey points and utilizing "Surfer" and "Matlab", two commercially available software packages, an accurate bottom bathymetry of the scour hole development was obtained. (See Appendices A and B)

The primary instrument utilized in this study was the fixed underwater video camera. It was designed to monitor the scour process around the clock, recording 20 seconds of video at 10 to 15 minute intervals. By mounting a scale to the pile prior to the fill operation, it was possible not only to monitor the scour sequences, but also verify the maximum depth. It should be noted that the author fully understands that a video camera will not work in many if not most areas that are subject to scour, primarily due to the turbidity in most tidal inlets. The thought process here was to attempt the capture of the cyclic scour process, and perhaps time lapse the event in a manner that would allow the

scientist/engineers analyzing the data to better picture or understand the environment in which they were working. In areas that do have relative clear water, the video camera is an extremely powerful tool. Here it was used not only to capture the scour process for presentation, but to test the ability of video to measure scour depth and rate of scour. Given the proper setup and post processing equipment a number of quantities can be obtained from the video recording including turbidity, current speed and direction, level of turbulence, scour depth and time rate of scour.

Environmental data is extremely important when developing a baseline. In this study the primary environmental consideration was the current, and this was monitored by a Marsh-Mcbirney electromagnetic current sensor. At each video sampling, the current was sampled and recorded. In addition to current, a number of other quantities may be important, including wave height and direction, tide (water surface level), salinity, turbidity, and temperature. For purposes of this study waves were not considered an important factor in that the site was extremely protected from wave action. Tidal range at the East Pass rarely exceeds 8 to 9 inches, and during this study the range was only about 6 inches. The large tidal prism created by the Choctawhatchee Bay is what generates the rapidly moving currents that flow through the bridge. As a result no wave or tide gages were installed. In hindsight, and as a recommendation for future studies, it is recommend that these instruments also be utilized.

CHAPTER 3

FIELD TEST / DATA COLLECTION IN DESTIN

Selecting a test site

Why was Destin, Florida chosen as the study site? Selecting the proper test site was a crucial aspect of this project. With the primary instrument being the video camera, it was critical that the visibility be very good. In addition, it was desirable to have many of the variables which can affect the scour process isolated. The location chosen was very protected from waves, the depth of water remained relatively constant with the small tidal range experienced in this part of the Gulf, and the bottom sediment was white sand with an average D_{50} (median sediment diameter) of .28mm. In addition the site was very accessible, the local area infrastructure provided all the necessary support, the water was shallow (less then 5 meters, except in the main channel) and allowed for long diving days as needed, and the tidal prism created by the Choctawhatchee Bay was large enough to provide a significant current in both directions. Combine all this with the East Pass Bridge structure and a near perfect test site emerges. The bridge itself is a twin span, pile supported structure. Each bent consists of 5 piles and a pile cap. Though the spans were constructed at different times, the bents for each span were placed side by side for most of the bridge. In effect you have 10 piles in line for each bent.

Preliminary Survey

Before fielding any project, if possible, it is desirable to visit the site and conduct a preliminary survey. This was accomplished several months in advance of the actual field phase of the project, and proved to be an extremely good use of limited time. The preliminary survey consisted of a one day trip to survey and sample the bridge site. A variety of piles were surveyed and holes ranging in scour depth from 0.5 to 4.5 meters were measured. Simple speed tests using drogues confirmed surface currents in excess of 0.4 meters/second. Measurements of the bridge catwalk rail and existing pile structure were taken to facilitate the recording platform design and installation. Sand samples to verify bottom sediment size were also taken. In addition, stops at the local Coast Guard station and several marinas established a liaison that proved very helpful during the 10 days of the project when additional support was required.

Equipment Assembly

Equipment for this project was assembled and tested at the University of Florida, Coastal and Oceanographic Engineering Laboratory. It is worth noting that due to limited resources, some of the equipment that was chosen for the project, was selected primarily for it's availability as opposed to being the "best tool for the job". Even with using these "odds and ends" and piecing together the data collection package, a very capable system was developed. Some comments on improving on the equipment for future research are included in Chapter 5 under lessons learned.

As mentioned before, the sensor array consisted of an electromagnetic current meter, an acoustic transponder, an underwater video camera and two underwater lights. The

lights demonstrate how ingenuity overcame lack of funds throughout the project. Lights designed and manufactured for use in the underwater marine environment proved to be very expensive. An inexpensive, yet effective alternative was to use sealed beam halogen headlights. The lights were mounted inside PVC tubes to facilitate there installation on the instrument frame. The cables were simply potted on the back of the lights. These lights were tested to a depth of 8 meters and installed for 10 days at a depth of 3 meters. They performed flawlessly.

The instrument array was cabled to the controller/data recording box. This box was constructed from a surplus aluminum equipment box with a gasketed lid. It housed an 8mm VCR, character generator for putting time tags on the video, a Tattletale IV controller and datalogger, a relay panel constructed so that the tattle-tale could turn the equipment on/off as required, and a 250 watt inverter. The inverter provided power for the 110 volt AC equipment which consisted of the VCR, character generator, and Mezotek. To control the VCR, a standard universal TV/VCR remote control was modified so that the Tattletale controller would be able to interface with the VCR and control the video recording functions also.

The operating duty cycle was performed in the following sequence.

1. Inverter on
2. Power up - Camera, VCR, Mezotek
3. Command VCR - on to allow warm-up and start sequence
4. Lights-on
5. Command VCR - rec/play for 20 seconds of recording.
6. Record 10 data sets of X and Y channels from the current meter, depth from the transducer and time/date on the datalogger at 1 second intervals.
7. Command VCR - off to allow for shut down sequence
8. Lights - off
9. Inverter - off

This sequence occurred every 10 minutes during the first few days while the scour process was very active and then was scaled back to every 15 minutes for the rest of the study. See Appendix C for the computer program (written in BASIC) used for the controller.

Power for the system was provided by two 12 volt, deep cycle marine batteries. The lights, camera, and inverter were powered by a single 127 amphour battery. The transducer required a 24 volt input so a second, smaller 100 amphour battery was placed in series to obtain the 24 volts. The primary battery required changing every two to three days, the secondary battery remained throughout the entire test period without significant current drain.

During these battery maintenance times, a Zenith-286 portable computer was interfaced with the Tattletale controller and the data logger was downloaded to ensure no loss of data. The super 8 video tapes were also exchanged. The video recorder was set to operate on standard play, and up to 2.5 days of data could be captured between changes at 6 recordings per hour. When the system was set to operate at 4 recordings per/hour almost 4 days of video could be recorded per tape. Though the data was downloaded almost daily, and tapes and batteries changed every two days, measurements of the voltage drops indicated that had the system been set to record in the extended play mode, and two batteries placed in parallel for the primary battery, an unserviced time in excess of 8 days would have been possible.

In addition to the electronics package that was designed for this project, other pieces of hardware had to be developed as well. One of the major points to be evaluated was the

ability to gain accurate data on the scour process by filling an existing scour hole and observing it scour out again. To accomplish this a large volume of sand had to be moved. A dredge and fill process was designed to accomplish this task. A 4 inch trash pump, commonly used in construction to dewater excavations was used to power the dredge apparatus. A manifold was constructed that would accommodate two 2 inch suction hoses. The manifold also incorporated a two inch stack, which was valved to control the amount of bypass water. The suction and discharge hoses were assembled using 10 foot lengths of tubing with quick disconnects on each end. The first 20 feet of hose was assembled on the boat and attached to the pump. The remaining hose was assemble on the bottom and led from the boat to the borrow area and from the boat to the fill area. The manifold was attached to the suction end of the pipe. Two 15 foot pieces of 2 inch hose were attached to the manifold for the divers to control the intake of sand from the borrow area. The four inch diameter hose is far to heavy and stiff to be worked directly as the dredge intake. As a result the manifold with two hoses and bypass was attached to the end of the intake pipe. During the fill process the discharge end was also manned and periodically moved to allow for more even placement of the fill.

An overnight trip which allowed for the equipment to be tested at the study site was performed three weeks prior to the actual project work. During this time the dredge equipment was tested and proved to be an effective method for moving sand. The area was surveyed once again and a tentative project site was chosen. The video equipment was tested, both day and night, with several major problems discovered primarily with the power source and outside electronic interference affecting the video quality. Final

measurements were made of the piles and bridge rail to site adapt and refine the equipment mounting arrangements.

Equipment Installation

The installation plan was relatively simple, confirm the site, install the instrument support framework, mount the instrument recording box and battery package to the bridge rail, install, connect and test all the instruments, fill the scour hole, and monitor the scour process.

In reality the setup process, took a well coordinated two days to accomplish. The first day consisted of a quick survey to confirm the test site. The site selected was bent 15, outboard pile on the south side of the bridge. (i.e. the Gulf side) The bents are numbered west to east. The scour hole selected was slightly over a meter deep. The hole associated with the various piles had connected to form a scalloped trench that ran along the piles. First the framework was attached to the pile. The lower frame clamps serve as the reference level for all the manual surveys and are located at a depth of 2.4m below MLLW. A scale made of a 1x4 plank painted white with black reference lines was mounted to the side of the pile to be videoed. The scale was marked in centimeter increments with full width lines every 10 centimeters which are numbered from the bottom up. The lines are 1 cm wide and every 5th line is elongated to show the 15, 25, etc. locations. Prior to mounting the framework all the oysters, barnacles and other biofouling were scraped from the pile. There was 3 to 4 inches of growth on all sides of the pile, and the pile effective diameter was much larger then the 24 inch square pile that was left after scraping. It would also be interesting to look at what the pile roughness, or

what equivalent roughness and effect it has on turbulence of the flow and associated scour. But we will have to leave that for another study.

The recording equipment box was mounted to the bridge rail using banding material and clamps. Work on the bridge was facilitated by a full size emergency lane in which to park the vehicles as well as a 5 foot wide pedestrian walkway that was separated from the traffic by a 3 foot high "Jersey Wall" barrier. The bridge deck at this point was 22 feet above the water.

The following day, instruments were mounted to the frame and attached to the recording equipment. The process was made easier by lowering the instruments from the bridge to a support team in a small boat tethered next to the study pile. A team of two divers working below the water completed the installation crew. The cables were all supported and tied with large plastic electrical tie-wraps. After the equipment was mounted the process of aiming the instruments was conducted. It proved no small task to coordinate the divers moving the camera to just the right viewing angle, with the monitor being located 22 feet above the water on the bridge deck. After a number of try's the camera was aimed so that the point represented by the bottom, right hand side of the exposed pile was in the lower right third of the monitor. This gave the best presentation of the entire scour hole, and would allow visual monitoring of the scour process after filling the hole without moving the camera or changing the camera angle. The transducer was aimed at the base of the exposed pile to track the maximum depth of scour.

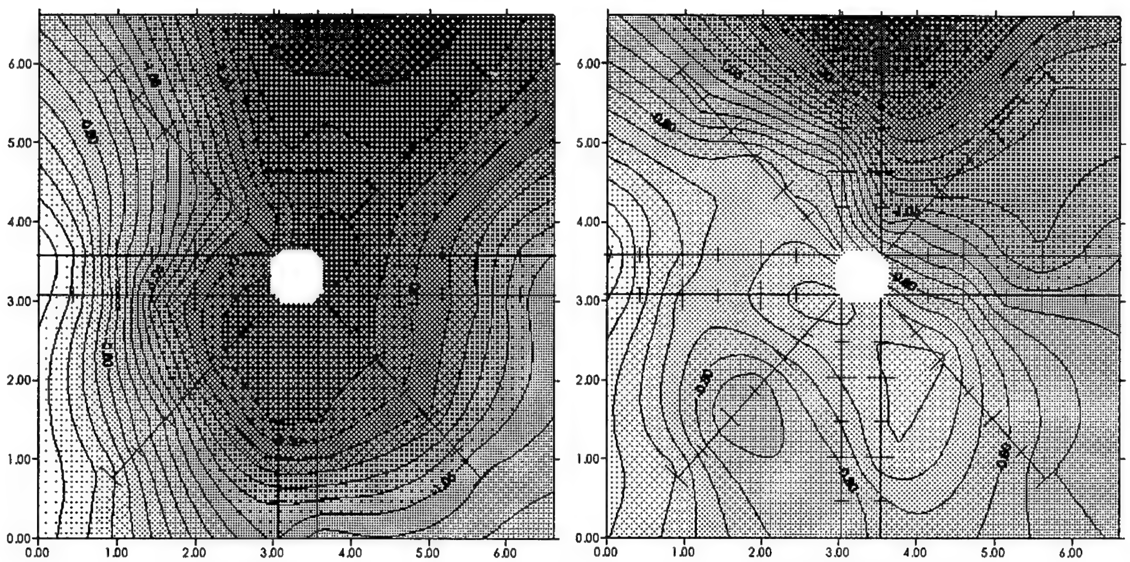
The electronics team from the Coastal Lab continued to "tweak" the electronics for best data collection for several hours. Their efforts were not wasted, as the package performed almost flawlessly for the next 8 days. There was only one 5 hour period where the data collected by the electronics was off the scale and obviously in error. No explanation for this data set has been determined to date. This problem and how the data was handled and manipulated will be discussed in the next chapter.

Filling The Existing Scour Hole

After the equipment was installed and functioning, the pipe was laid to begin the dredge and fill operation. The process developed during the equipment trial worked very well with two divers working the suction hoses and one diver working the discharge pipe. The borrow area was approximately 25 meters to the south of the test area, located 90 degrees from the direction of flow. By locating the borrow area in this manner it was hoped to reduce or eliminate any impact that the borrow area would have on turbulence in the test area. The fill process started at 1215 and continued for almost 6 hours until 1800. Prefill and postfill surveys indicate that over 10.8 cubic meters of sand were moved to fill the hole within the survey boundaries. The survey boundaries extended 3 meters from the pile in all directions. To achieve a level bottom profile for the test it is estimated that approximately 15 cubic meters of sand were moved, some being lost to the current during the fill and some filling areas outside the survey area.

Manual surveys were conducted to plot the bottom contours and record the changes caused by the scour. The surveys were conducted using the bottom clamp for the instrument frame as a reference. A 3 meter, metal straight edge was placed so that one

relative to the pile. The second diver using a 1.5 meter stick would measure the distance from the level reference to the bottom. Measurements were taken every half meter from the edge of the pile out to 3 meters. Twelve lines per survey were measured. See Figure 3.1 below for pre and postfill surveys and lines showing survey points. A description of how the contour and surface plots were made follows in chapter 4.



Prefill Survey   Postfill Survey

Figure 3.1 Prefill and Postfill Contour Plots with Survey Points Depicted

<u>Fill Density</u>

One of the first concerns about filling the hole, and monitoring the scour process was the compaction or density of the fill. An attempt was made to measure relative compaction by using a "mini-pile driver" device. This device would measure relative densities based on depth of penetration for a given blow count. The device, though easy to work with on land or in calm water, proved unmanageable in strong currents. The intuitive response from the test personnel was that compaction of the sand was significantly less than the surrounding unfilled bottom. Immediately following the fill, the

fill sand was easy to move and penetration was relatively simple. However, by the following morning the density of the fill sand was indistinguishable, from the surrounding area. It appears, that in a very short time, the compaction of the fill was solid enough to consider it a close representation of the undisturbed sand bottom. Future tests would be enhanced by improving on the density test procedures and determining the actual compaction of the sand prior to scour.

Problems

The preceding pages make it sound as if this portion of the project went without it's share of difficulties. In fact by the end of the first two days on site several of the divers had spent more then 13 hours underwater between surveys, equipment installation, testing, and finally filling the existing hole. Fatigue was a potential problem that could have led to serious problems. Although a number of items that can be improved upon will be covered in Chapter 5 under lessons learned, the manpower aspect of this project deserves mentioning at this time. The project was installed by 4 individuals, with additional technical support by one more person during the instrument installation and testing. This author would not recommend attempting this project with less than 5 personnel, qualified to work all aspects of the project, particularly the diving. More fill would have been desirable, but time and manpower were severe constraints. Safety could have become a major problem if not for the extreme professionalism and positive attitude of the entire team. In hindsight an additional one or two personnel would have solved or alleviated many of the small problems that were overcome through diligence and determination.

When the data is reviewed in Chapter 4, there are several time periods where surveys should have been taken. One was missed due to bad weather and the inability to put divers safely in the water. The rest were due to having only one person at the site. There were several times when surveys could not be conducted due to limited personnel.

To verify that the video was recording and operating properly, a monitor had to be brought to the bridge and hooked to the VCR to watch the video. In the future, installing a small monitor as part of the package with an adequate power source would be a good idea. The current data collection system works, but is very cumbersome and time consuming to monitor on a regular basis.

Though the pre and postfill survey indicate that the bottom surface level was raised almost 0.8 meters, the hole was not completely filled. For future reference this system is able to move an effective 2 cubic meters of sand per hour. This rate is calculated using the pumping time only and does not include the set-up or tear down of the system. In calm water the effective rate might be slightly higher. It would also be a good idea to bring a spare belt for the pumping equipment. The belt on the pump failed and the pump had to be left running for fear that it could not be restarted.

Tourist and curious onlookers were not a problem for the installation phase, mainly because the system was installed during the work week. It was obvious from the traffic experienced during the weekends, the installation would have been impossible at this site on a summer weekend.

The strong currents experienced by the divers made work in conducting the surveys extremely challenging. The U.S. Navy will not allow SCUBA divers to work in currents

greater then one nautical mile per hour, or 0.5 meters/second. At times the currents in the vacinity of the pile approached this limit. It is easy to see why this limit was established as the divers were almost unable to fight the strong currents. This is yet another reason to support the development of remote monitoring equipment. At the times when the data is hardest to obtain is exactly when the data must be taken. Despite the strong currents, the bottom surveys conducted were very accurate. This is in large part due to the simplicity of the survey equipment. Clearer markings on the survey staff and waterproof headlights worn by the divers would have made the job go quicker and easier.

The System Actually Works

Though the actual data collection results will be presented in Chapter 4, it is important for the reader to understand that even with all these problems, the system performed very well. Visibility was such that at no time was the pile completely obscured. The entire scour process was monitored and documented for a full 8 days. The hole scoured to it's previous depth. Current speed and direction were recorded in the vacinity of the pile, maximum depth of scour was recorded by the acoustic transponder. The video never missed a picture, though some were partially obstructed by fish. In short, even when the divers could not go in the water to physically monitor the process, the electronic equipment worked, and worked well. The following chapter presents the data obtained during the study.

CHAPTER 4

DATA COLLECTION RESULTS

Manual Surveys

Surveys were conducted at the study site twice a day, once in the morning, and then again in the evening. As described in the previous chapter the surveys required divers to physically measure the bottom bathemetry. The surveys were conducted by taking readings every half meter on twelve lines that radiated from a 24 inch square pile with chamfered edges. The physical shape of the pile made if very easy to verify alignment, and insure that the surveys were made in the same position each time.

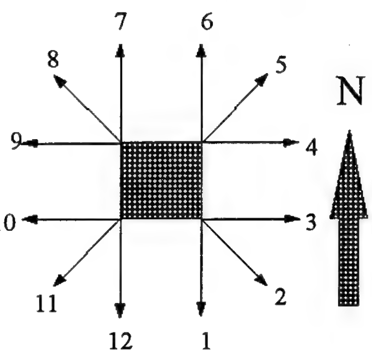
There were 14 surveys conducted over the test period. This includes the prefill and postfill surveys, labeled 1 and 2. When reviewing the surveys it is very important to note the time of survey, as there are several time gaps where surveys were not conducted. The data recording from the electronic equipment started immediately following installation, and as a result the fill process is captured. The scour process started at the conclusion of the fill process, and a third survey was conducted the following morning. There is a 21 hour period between surveys 3 and 4. This was due to limited diver availability.

From 18 August at 1830 (survey 4), to 23 August at 0900 (survey 13), readings were taken consistently morning and evening. There is a 24 hour gap from 13 to 14 due to bad weather. The following page is an example of a survey data sheet. The surface and contour plots were generated from the measurements taken. See appendices A and B for a full set of data sheets and larger plots that show greater detail of the bathymetry.

Manunal Survey Number 01

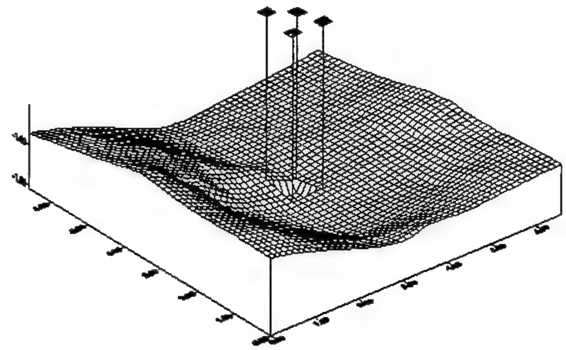
16 August 1995 0900

Survey Crew: Wayne Walker
Bill Miller

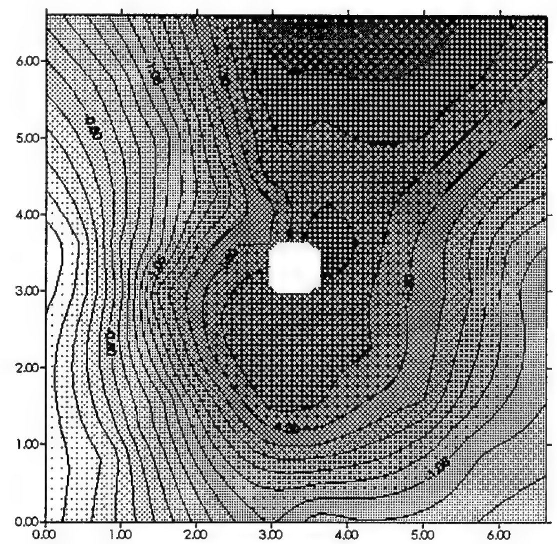


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot



Contour Plot

Raw Survey Data

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.38	1.37	1.36	1.35	1.25	1.10	0.97
2	1.38	1.37	1.35	1.30	1.25	1.10	1.00
3	1.38	1.37	1.31	1.27	1.21	1.07	1.01
4	1.45	1.40	1.33	1.27	1.20	1.10	1.05
5	1.45	1.40	1.37	1.38	1.40	1.39	1.40
6	1.45	1.40	1.38	1.39	1.42	1.47	1.55
7	1.30	1.29	1.39	1.40	1.43	1.45	1.51
8	1.30	1.25	1.15	1.10	0.98	0.95	0.89
9	1.30	1.30	1.20	0.98	0.87	0.61	0.51
10	1.39	1.35	1.28	1.17	0.83	0.63	0.53
11	1.39	1.40	1.33	1.19	0.95	0.85	0.67
12	1.39	1.39	1.40	1.36	1.25	1.11	1.06

Figure 4.1 Sample Survey Data Sheet

Plotting the manual survey results

The survey points were first put into a spreadsheet. An attempt was made to process the 7x12 matrix using "Matlab" to generate the surface and contour plots. Due to Matlab's interpolation routines it was very difficult to gain an accurate picture as a result of the curving of the edges in an unrealistic manner. A program better suited to deal with surface or contour plots is "Surfer", by Golden Software. The 7x12 matrix was introduced into the program and a 50x50 matrix was generated. It is the 50x50 matrix, generated by interpolating between all the points in the 7x12 matrix that is presented here. The 50x50 Surfer generated matrix is equally spaced to provide for a better 3D surface plot. By taking this 50x50 matrix and importing it directly to Matlab, with no interpolation, there was no curling of the edges. Matlab was then used to produce a time-lapse like "movie" of each of the surface plots played sequentially. It allows the viewer to better visualize, in a matter of seconds, the scour hole being filled and scouring out again.

Surfer provides a host of other functions, in particular the ability to calculate the volume difference between two surface plots. Some very interesting correlation's were observed when combining the volumetric rate of scour, with plots of the current's speed and direction. First let us review the video data and also cover the other sensor data that was obtained.

Video Time Lapse

The video camera was mounted in such a manner as to effect the observation of the scour hole development. Initially, all the data was collected on a 15 minute interval.

Every 15 minutes 20 seconds of video would be recorded along with 10 samples taken at one second intervals from the current meter and acoustic transponder, which were recorded by the datalogger. It was noted that the rate of scour was accelerating as the hole initially developed. To better capture this the recording schedule was accelerated to once every 10 minutes. This schedule remained for two and a half days until noon on the 19th of August 1995. At this time the recording was scaled back to 4 times each hour as the scour process appeared to be slowing down.

The video was then post processed and a pseudo time lapse was made of the 8 day period. Essentially one second from each of the 20 second recordings was copied. The one second recording gives the impression of a time lapse film, with the 8 days being reduced to just over 11 minutes. At the same time the one second "snapshot" shows current direction and gives a qualitative measure of the speed of flow based on the movement of floating particles. At peak flows the level of turbulence and sand movement is impressive. The turbidity of the water was a concern, but proved to not be a problem. Throughout the video the scale is fully visible. The maximum depth of scour is easily viewed. The viewer can observe the sand scouring out, and then the scour hole being refilled as the tide reverses. It is this scour and fill sequence which is repeated throughout the period that is most interesting.

Though the camera and lights used were very effective in monitoring the scour development, it is by no means a perfect system. Some areas to improve on would be enlarging the scale which was mounted to the pile and using a more diffused light. These

and other ideas for improvement of the recording process are discussed fully in the following chapter.

Data manipulation

A Tattletale IV (the trade name for a microprocessor based datalogger, manufactured by Onset) was used to control the recording equipment. It also served as the datalogger to record all the data from the Mesotech and current meter. The data was periodically downloaded to insure that, should a failure occur, only a minimum quantity of data would be lost.

Both of these instruments were calibrated for this experiment. The Marsh-McBirney in the flume, and the Mesotech in the field. These calibrations will be discussed later, and were critical to the successful data reduction. The current meter delivers two signals, one for each of the two orthogonal directions x and y. These signals are voltage changes generated by water flowing by the sensors. Knowing the orientation of the sensor, and having developed a reference signal during the calibration it is possible to obtain not only speed but also direction. The Mesotech was calibrated after installation. By taking and bouncing the signal from a known distance the offset for the device could be determined. In this case, divers held a 2x3 foot metal plate at known distances from the transducer. The readings were recorded and then corrections were applied to the remainder of the readings. The entire calibrated set data is presented in Appendix D.

Current Speed and Direction

As there were several obviously bad data points collected, and the data shown in Appendix D is not smoothly time averaged. To allow a better presentation, the time in

cumulative minutes is presented along with the clock time and date. To obtain the current speed and direction the x and y coordinates were plotted and the system mean removed. The tidal speed and direction are plotted below. The top dotted line represents the water flow heading, while the bottom solid line represents the speed.

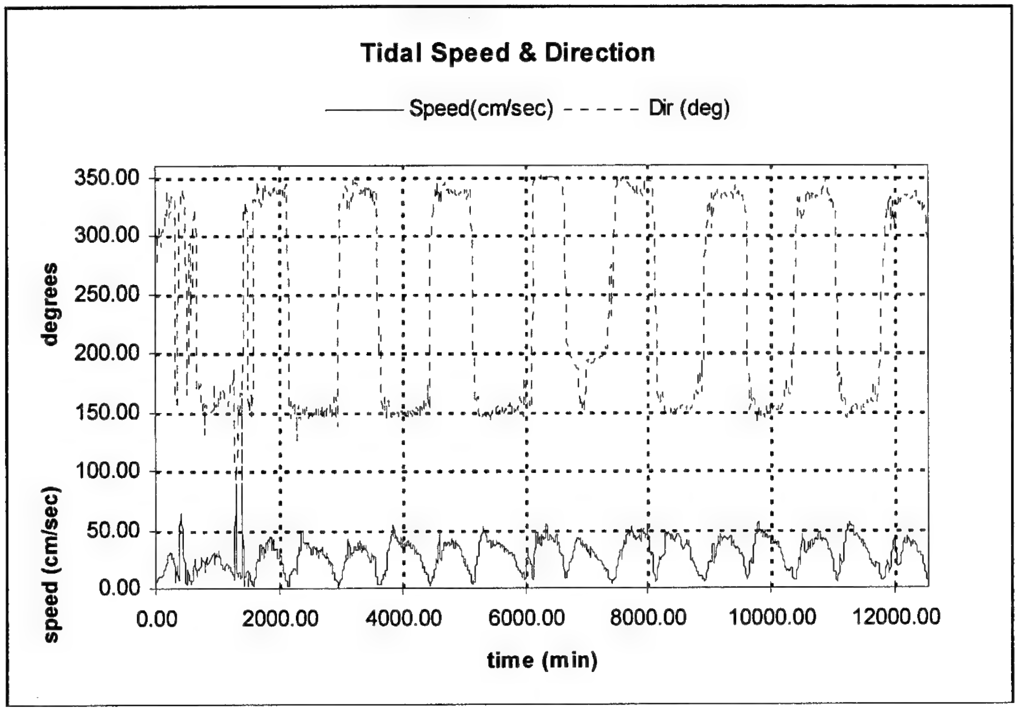


Figure 4.2 Tidal Speed and Direction Plot from Marsh-McBirney Data

The current direction refers to the heading of the current relative to the pile. See the sketch below.

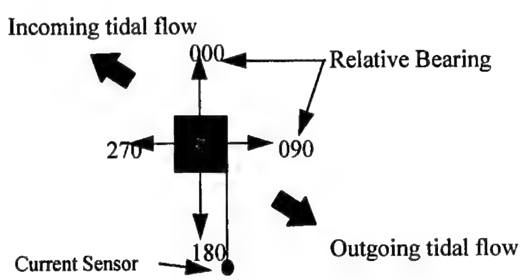


Figure 4.3 Current Direction Relative to the Pile

First note that the current velocity spikes to a peak velocity at the beginning of each of the outgoing tides. This does not imply that the current is faster on the ebb tide all across the tidal inlet. Remember that this data set is for one location in this particular tidal inlet. But this higher outgoing velocity results in an interesting scour pattern. Review Figure 4.4, the time averaged Mesotech scour depth data with the current velocity overlaid shown on the following page.

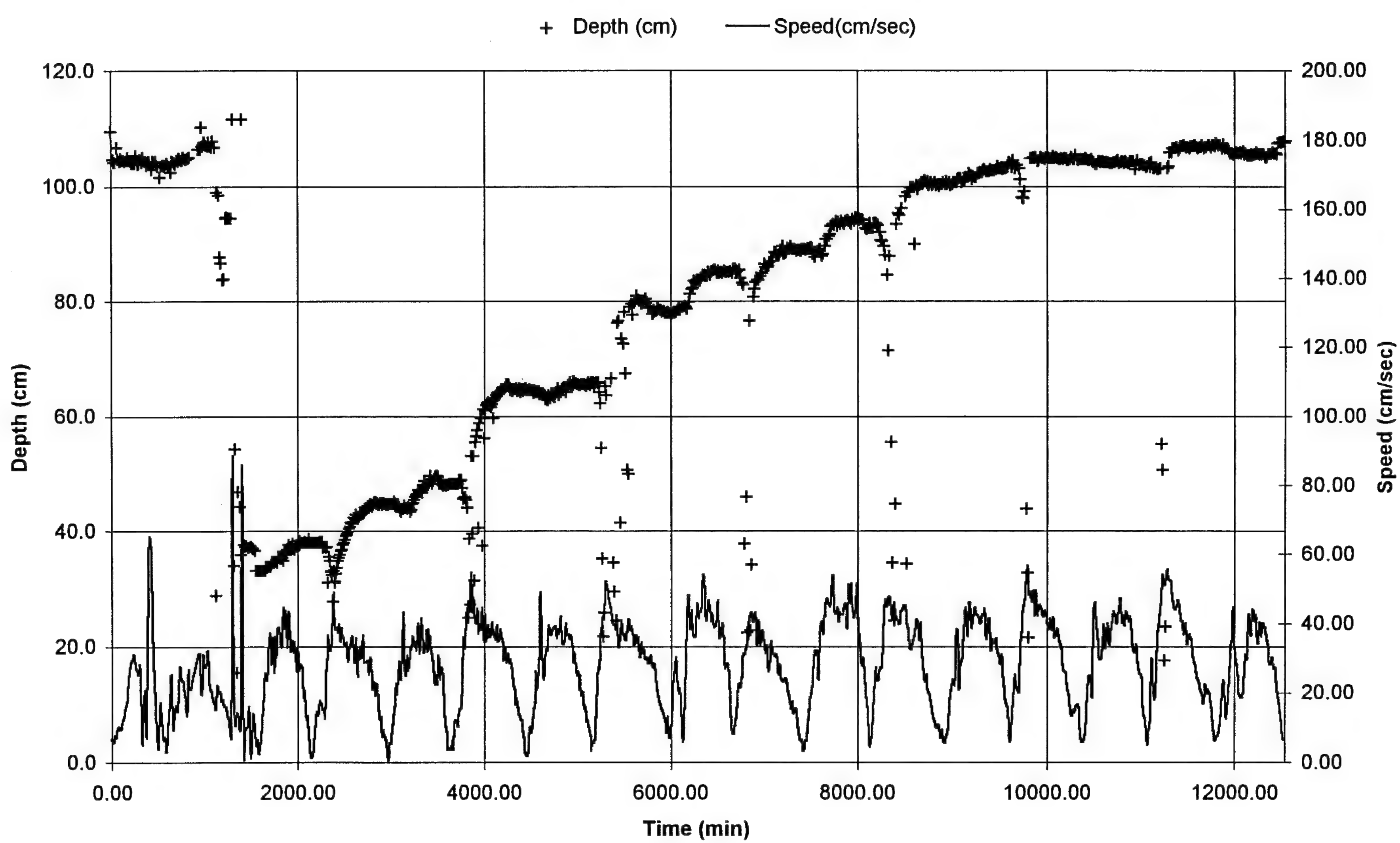
The Mesotech transponder was set to record the maximum depth of scour at a point near the base of the pile. The base of the Mesotech was located at 110 cm on the scale that was attached to the pile. The depths shown are relative to the Mesotech position as it was fixed to the pile. At time zero the recording reflects the 110 cm depth of scour, then the scour hole fill process is represented as the depths rapidly become shallower. The video camera clearly shows a depth of fill to be just below the 80 cm mark on the scale or almost 30 cm for the Mesotech location. As the depth increases several items should be noted.

1) Rate of scour is greatly increased on the outgoing tide. By observing the slope of the curve on each of the outgoing tides it is easy to observe that the depth is increasing more rapidly then it does on the incoming tides.

2) Incoming tides partially fill the existing hole before the depth starts to increase again. This is a very important aspect of these alternating flow scour events. As the tide reverses course it fills the existing scour hole to a degree.

3) Coupled with the fill of the scour hole on the incoming tide the rate of scour is reduced as evidenced by the milder slope. When observing Figure 4.2 it was noted that

Figure 4.4 Mesotech Scour Depth



the incoming tides did not reach the maximum velocities exhibited on the outgoing tide. This in part would explain the slower scour process but not entirely.

4) As the velocities peak on the outgoing tide there is greatly increased turbulence and associated turbidity in the water as the flow transitions to a live bed situation. This is confirmed in the video of the outgoing tides with significantly increased suspended and bed load transport. This can also be seen in the increased scatter in the Mesotech output at the peak velocities. The cloud of sediment created a screen that the acoustic transponder could not penetrate. Note that the greatest depths occur at the times of peak velocity. Additionally the geometry of the bridge piers obviously adds to the increased turbulence on the outgoing tides. On the outgoing tides the water is impacting the bridge piles at an angle of 30 degrees as the heading averages 150 degrees relative. The increased turbulence is due not only to the increased speed of the water, but also to increased roughness in bottom topography and number of obstructions in the flow with the other associated piles and various portions of the bridge structure that must be passed before reaching the test pile. On the incoming tide, the water flows over a relative smooth bottom and meets no obstructions before reaching the test pile.

5) As the scour depth approaches equilibrium it is difficult to say that the rate of scour has diminished or if the geometry of the new scour hole is such that the scour only occurs at the peak velocity surge on the outgoing tide. In the data represented here, as the scour hole approaches the original equilibrium depth the last two recorded outgoing tides demonstrate an initial scour and then show the depth remaining constant. This is followed by a fill of the scour hole on the following incoming tide.

Again, it is important to remember that this is one data set at one pile for the entire bridge structure. However it is readily evident that at this location there is a net sediment transport downstream on the outgoing tide that is not recovered on the incoming tide until the hole approaches it's equilibrium scour depth. This is confirmed in part by the manual survey data. With the bottom bathemetry established using Surfer, the data can be processed to yield a differential cut or fill between surface plots. To be completely accurate the surveys would have to have been performed during the tidal change as the current changed direction. For this data set, the surveys were not taken during the change in tide, but many of them were taken shortly before or shortly after the tide change. As such, the differential volumes are not definitive, but do give a close approximation of the volume changes brought about by the opposing tidal currents. Figures 4.5 and 4.6 summarize these volumetric rates of scour.

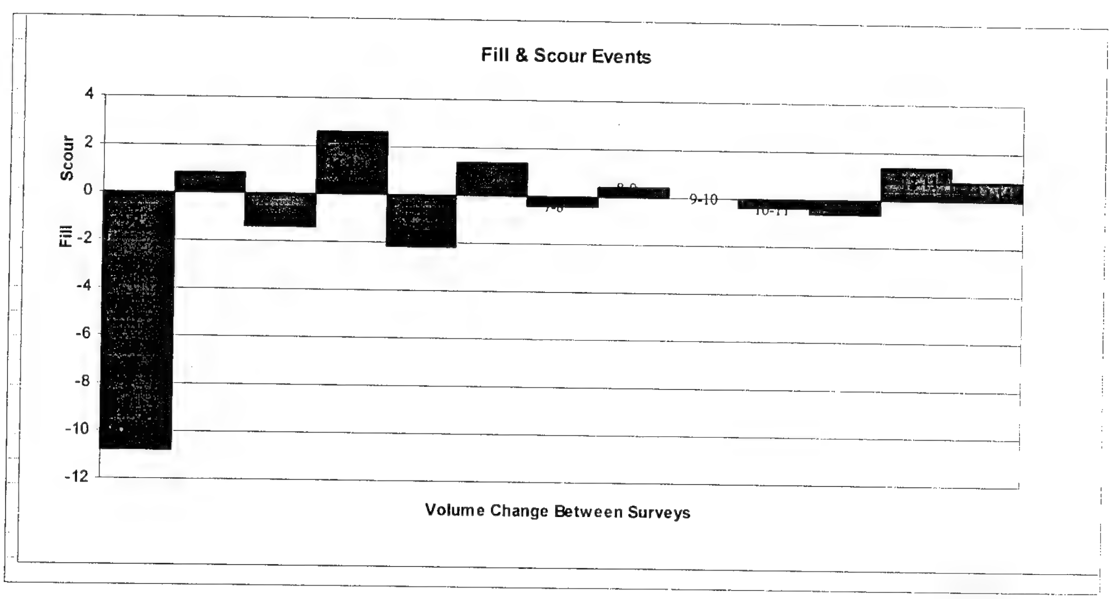


Figure 4.5 Volume Change Between Adjacent Surveys

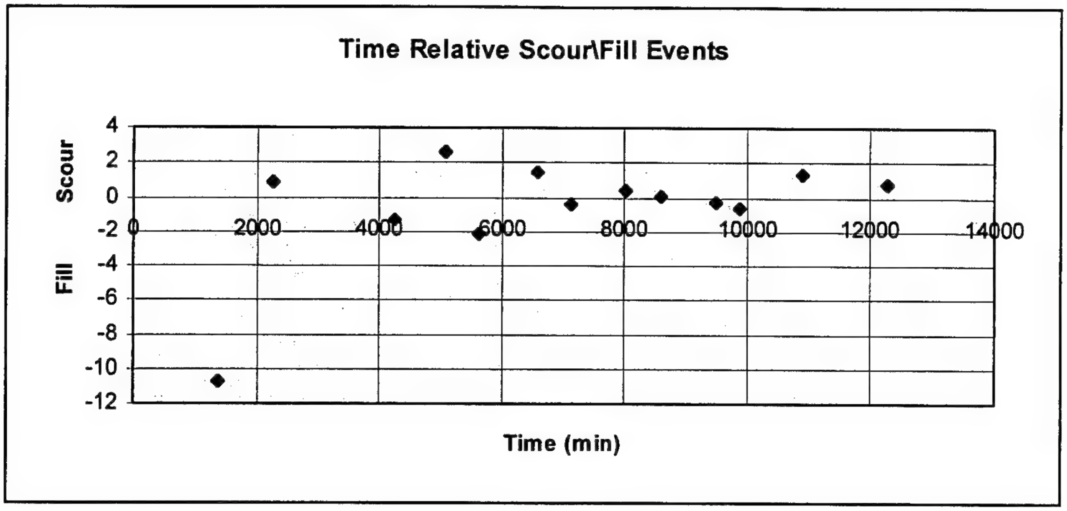


Figure 4.6 Time Relative Scour\Fill

In Figure 4.5, the differential volume between each successive survey is recorded. Had this data been recorded as the tide changed direction a more accurate picture of the net sediment transport would be available. However, with the data presented there is a clear alternating between the various tidal flows. Where the Mesotech data only represents one point in time and space, the survey represents an area of over 36 square meters. The lines below zero represent fills to the survey area, those above cuts or net removal of material. As mentioned earlier several surveys are missing but the data between surveys 4 and 12 clearly demonstrates this Scour\Fill sequence.

With this in mind, Figure 4.6 gives a time relative plot with volumes once again noted by position above or below zero. This diagram also graphically shows the scour hole as it approaches equilibrium. It is similar to the Mesotech data, demonstrating the net transport in the direction of the outgoing tide, and a relative change approaching zero as the scour depth approaches equilibrium. It should be emphasized again that this is one

survey set, at one point. A more comprehensive and detailed study, across the inlet, would be required for total verification. See Appendix E for the full volumetric rate of scour analysis.

CHAPTER 5

CONCLUSIONS AND LESSONS LEARNED

Summary

As stated in the introduction the goal of this project was to develop the equipment and procedures necessary to capture the scour process as it occurs in the tidal inlet. As a first step in this effort, the project was very successful. From an equipment standpoint, the physical evaluation and remote monitoring of the scour hole is a proven possibility. Future refinement of the techniques and equipment will no doubt provide a more accurate and complete data base concerning the tidal driven, alternating, local pier scour found in tidal inlets. It is obvious that much work still remains, particularly in the area of data analysis, but the basics for monitoring scour holes using underwater cameras and other remote sensors has been established. The video camera, and for that matter other remote sensors are only tools. And in the investigation concerning pier scour in tidal inlets, it will take all the tools and a lot of hard work to obtain the data required to develop comprehensive, concise, design criteria.

The camera is extremely useful, but only in clear water. And then it requires the right position or angle, proper visual references, adequate light, and constant maintenance. Acoustic and electromagnetic sensors are also valuable, but must be "tuned" to the environment. As recorded in this study, current flow, with extremely high sediment loads

may make the acoustic profiler all but useless. A tremendous amount of field work remains to obtain, verify and clarify the data to create a credible data base on which to ratify theoretical equations and scale versus prototype design procedures.

The data presented here is believed to be a credible set, but as stated before, it is only one set, taken at one pile, in a very large and complex tidal inlet. The data as presented points to several areas for future study, including time rate of scour, volumetric rate of scour, and equilibrium scour depth for scour holes in this tidal inlet (i.e. alternating current) environment. With the proper tools it is possible to remotely monitor all these functions, and with time and effort the problems currently faced in the design arena will be solved.

Lessons Learned

The following is a list of items that document some of the equipment problems, test procedure concerns, and other suggestions on areas to improve or significantly reevaluate for the next test. These are items that have not been presented already in the text, or items that deserve additional comments to clarify.

Electronics and Saltwater

The box used to weatherproof the control and recording equipment worked very well. There were no significant problems with water intrusion or problems associated with high humidity. This is due to extreme care being exercised while sealing the box. The lid was gasketed, and the cable weatherheads were sealed by stuffing closed cell foam around the cables and plugging the holes. An airtight seal was not achieved, nor would it be desirable. Heat build-up was a concern with sealing this equipment in the box with no air

circulation. Originally, the plan called for the box to be vented, with the addition of a solar powered vent or dorad as found on some sailboats should the vent alone not be enough. This was not utilized for fear of the high humidity and saltwater environment. Instead all the high heat output equipment such as the inverter were mounted in a manner that used the aluminum skin of the box as a heat sink. Due to the short duty cycle, sun shade, white paint, and heat dissipative mounting, the temperature was never a problem, even with the box totally sealed.

Redundant Systems

If it can go wrong in the field, it will go wrong in the field! Certainly not a statement associated with the power of positive thinking, but one to live by when fielding a project. Especially when fielding a project that is electronics intensive. If at all possible, redundant systems would be an ideal safeguard for returning from the field with usable data. In particular, multiple current meters, and extra cameras and lights would be great asset. The current meter that was used in this project was functioning, but until the postprocessing it was impossible to verify that the data collected was valid. From a labor perspective, it would not take anymore time to install redundant instruments. Multiple camera angles would also have been nice to capture a more complete picture of the scour area. Extra instruments would have been a good insurance to have while conducting the research.

Security

The safety and security of the equipment was a prime concern early in the project. A great deal of very expensive equipment was located in a relatively open, easily accessible place. Large chains and heavy locks were used to secure the recording package up on the

bridge. And a small houseboat was stationed next to the test site and manned during the entire 10 day period, to discourage curious individuals from tampering with underwater cameras or lights. In hindsight, the concern was probably overstated. The package on the bridge looked like any other box mounted to a bridge and drew little attention from passing individuals. Only once during the 10 days did the glow emanating from under the bridge at night when the underwater lights came on attract any attention.

The houseboat was a very valuable tool. Perhaps not from a security standpoint, as much as placing the field team in the test environment for a full 10 days. A feel for the environmental impact of the tide changes, their magnitude, speed and direction, and the effect of storms was gained. It also greatly expedited production, with no time lost traveling to and from the site, launching boats, and positioning for the days work. From the time the crew awoke they were on site and ready to go.

Under the heading of security would fall the security of any vessels used and kept on station. To secure the houseboat and keep it's position constant for monitoring purposes a mooring was installed. This consisted of establishing a "Bahama Moor" with two anchors set 180 degrees apart. The anchors consisted of a chain placed around the outboard pile of bent number 14 and shackle to a line that ran along the bottom back to a 4 foot sand auger that was placed at the boats pivot point, or middle of the desired swing circle. The opposing anchor was also a 4 foot sand auger. This line was also led back and anchored again at the center point. An anchor ball with swivel was attached to these lines. The boat was then attached to the floating anchor ball. This kept the boat in position, secure, and yet easily able to get underway should the occasion arise. The intensity of

even a short summer thunderstorm must be experienced on the water to be appreciated. Do not skimp on securing the vessel, or the equipment.

KIS Principle

Often when working in the high tech environment of the laboratory it is easy to conceive of instrument packages and equipment that would be perfect to capture the data in an almost sterile, climate controlled environment. When fielding a project, Keep It Simple or KIS should be the watchword. Much of the success of this project can be attributed to the simplicity of the system.

Be Prepared

Long a motto of the Boy Scouts, when taking a project to the field be ready for any and all contingencies. The best way is to walk through the entire project in a "table top" exercise to discuss all procedures and required equipment, tools, or special needs. From this develop a checklist of items to carry. It is much easier to carry a few too many items than to stop the entire project while waiting for one video connector, or a role of duct tape.

Grid in Photo Background

In this project a scale was attached to the side of the pile facing the video camera as a visual reference. A more effective backdrop for future work would be to place a grid that covers the pile. Proper positioning of the camera, in conjunction with the right time tags on the video would allow for confirmation of various items such as current, a better reference for the various vortices captured on film, and bottom contour changes as the scour process changes the bottom topography.

Diffused Lighting

The underwater lighting for this project was constructed using halogen sealed beam headlights. This provided a very adequate light source, but the video imagery would have been greatly improved had the light been more diffused as opposed to focused in tight spots. The white sand bottom, helped in this case by reflecting much of the light, but a diffuser over the lights to spread the beam would have been more effective. The off axis lighting was also very effective. Much like driving in a fog with the high beams on, when the water contains a high sediment load, the light will be reflected back at the camera not allowing it to see the target. By using the off axis lighting the camera was able to view the process, even during periods of high turbidity. In some instances the camera was able to see more then the divers could as a result of the position and lighting.

Bio Fouling

The marine growth in the East Pass tidal inlet was nothing short of phenomenal. In a 10 day period the bottom of the boats were covered with dime size barnacles. Moss, algae, barnacles and oyster spats were continually attaching themselves to the instruments. To keep the camera, lights and other instruments clean they were wiped down twice daily during the regular surveys. In the future, projects that may be for the most part unmanned, should take this into account and plan on regular maintenance dives to keep the sensors in peak condition. The other alternative would be to counter the growth with some form of marine anti-fouling paint. It was interesting to note that on items where duct tape was covering the surfaces, the fouling was not nearly as significant.

Respect for Environmental Hazards

A healthy respect for the natural and manmade hazards are a must to safely install a project of this nature. The strong currents were a problem, and at times worked to pull the divers from the site. Diving in what amounted to a Jellyfish soup on several days was also very challenging. The natural and manmade obstructions covered in barnacles and oysters also were very rough on gloves and unprotected skin. When working around piles or structures covered with growth, or sharp objects such as rusty nails or exposed rebar it is advisable to wear some form of chafe gear. A simple pair of heavy coveralls over the wetsuit can be very effective in stopping scrapes, cuts, and punctures to the wet suits.

Sample Group Size

The last item to cover, would be the size of the samples. In this project 20 seconds of video were recorded every 10 to 15 minutes. This probably could be scaled back to about 10 seconds. It is not recommended to go much below this time, as often the picture was obscured by fish or other floating debris. To insure the capture of the submerged target extra frames should be shot. In addition 10 samples taken at 1 second intervals were utilized to capture the acoustic measured depth and current velocity components. This number appears to be about right. The sample size is large enough to smooth out the odd or spurious input, but not so large as to make the data manipulation cumbersome.

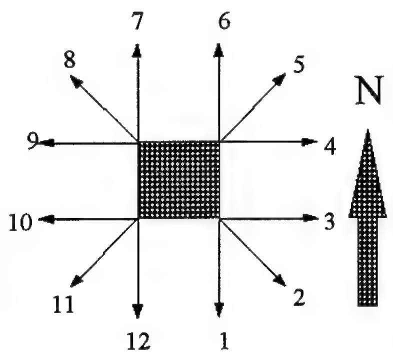
Appendix A

The following pages document the manual surveys conducted at the Destin Scour Study 16 August - 24 August

Manunal Survey Number 01

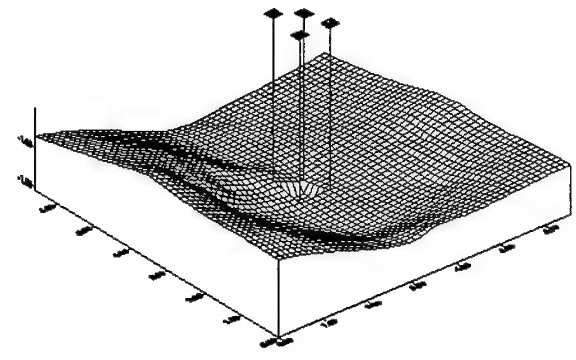
16 August 1995 0900

Survey Crew: Wayne Walker
Bill Miller

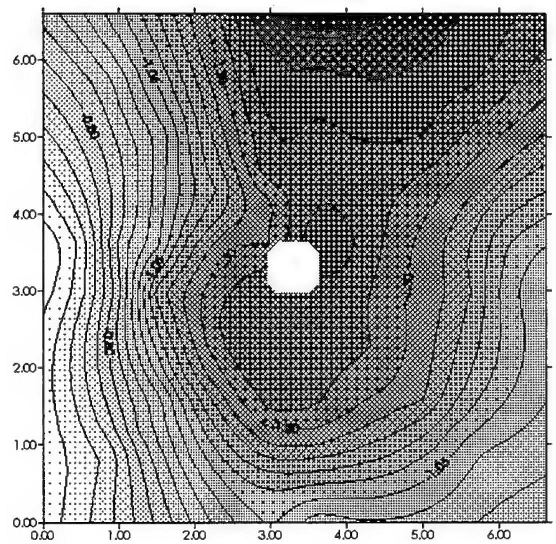


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot



Contour Plot

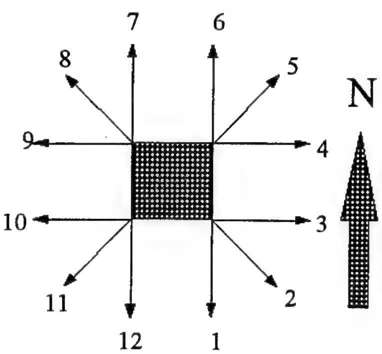
Raw Survey Data

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.38	1.37	1.36	1.35	1.25	1.10	0.97
2	1.38	1.37	1.35	1.30	1.25	1.10	1.00
3	1.38	1.37	1.31	1.27	1.21	1.07	1.01
4	1.45	1.40	1.33	1.27	1.20	1.10	1.05
5	1.45	1.40	1.37	1.38	1.40	1.39	1.40
6	1.45	1.40	1.38	1.39	1.42	1.47	1.55
7	1.30	1.29	1.39	1.40	1.43	1.45	1.51
8	1.30	1.25	1.15	1.10	0.98	0.95	0.89
9	1.30	1.30	1.20	0.98	0.87	0.61	0.51
10	1.39	1.35	1.28	1.17	0.83	0.63	0.53
11	1.39	1.40	1.33	1.19	0.95	0.85	0.67
12	1.39	1.39	1.40	1.36	1.25	1.11	1.06

Manual Survey Number 02

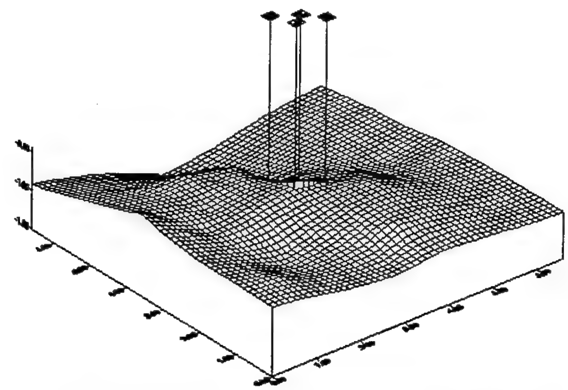
16 August 1995 1845

Survey Crew: Wayne Walker
Bill Miller

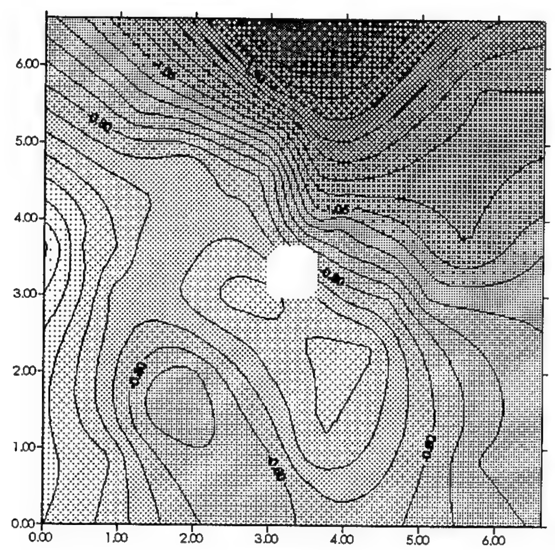


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot



Contour Plot

Raw Survey Data

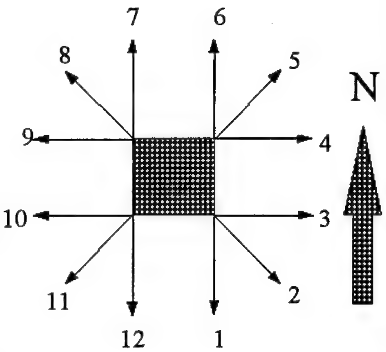
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	0.70	0.65	0.65	0.65	0.65	0.75	0.78
2	0.70	0.68	0.64	0.72	0.78	0.82	0.90
3	0.70	0.78	0.81	0.96	0.97	0.97	0.97
4	0.86	0.93	0.96	1.05	1.10	1.05	1.00
5	0.86	0.96	1.10	1.15	1.16	1.17	1.15
6	0.86	1.05	1.15	1.25	1.35	1.45	1.50
7	0.73	0.80	0.82	1.00	1.27	1.40	1.52
8	0.73	0.72	0.75	0.70	0.80	0.90	0.90
9	0.73	0.69	0.71	0.75	0.65	0.60	0.43
10	0.63	0.63	0.68	0.72	0.73	0.60	0.50
11	0.63	0.67	0.75	0.88	0.90	0.80	0.64
12	0.63	0.67	0.70	0.75	0.80	0.85	0.83

Manual Survey Number 03

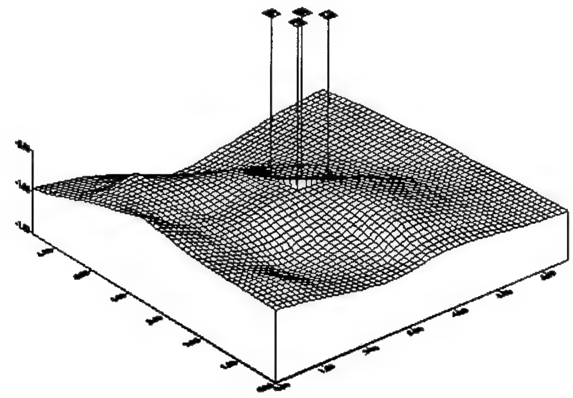
17August 1995 0930

Survey Crew: Bill Miller
Mike Bootcheck

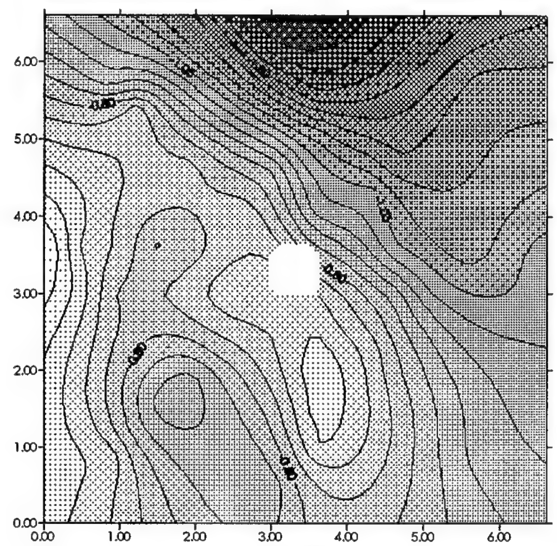


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot



Contour Plot

Raw Survey Data

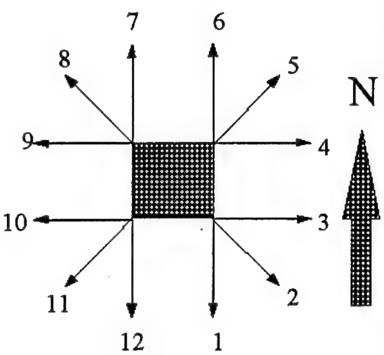
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	0.70	0.65	0.62	0.63	0.65	0.75	0.78
2	0.74	0.72	0.73	0.79	0.83	0.88	0.92
3	0.70	0.78	0.87	1.00	1.05	1.05	1.02
4	0.85	0.92	1.04	1.09	1.13	1.07	1.03
5	0.87	0.97	1.03	1.19	1.20	1.19	1.18
6	0.79	0.98	1.03	1.14	1.35	1.44	1.52
7	0.72	0.79	0.85	1.02	1.23	1.40	1.52
8	0.72	0.71	0.75	0.74	0.77	0.72	0.92
9	0.76	0.72	0.77	0.81	0.71	0.66	0.49
10	0.66	0.66	0.71	0.75	0.76	0.63	0.53
11	0.66	0.70	0.78	0.91	0.93	0.83	0.67
12	0.66	0.70	0.73	0.78	0.83	0.88	0.86

Manual Survey Number 04

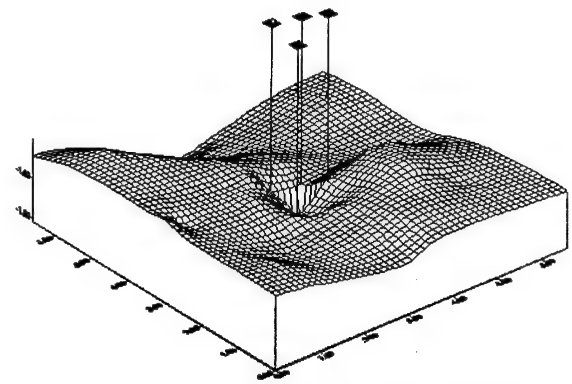
18 August 1995 1830

Survey Crew: Wayne Walker
Carl Walters

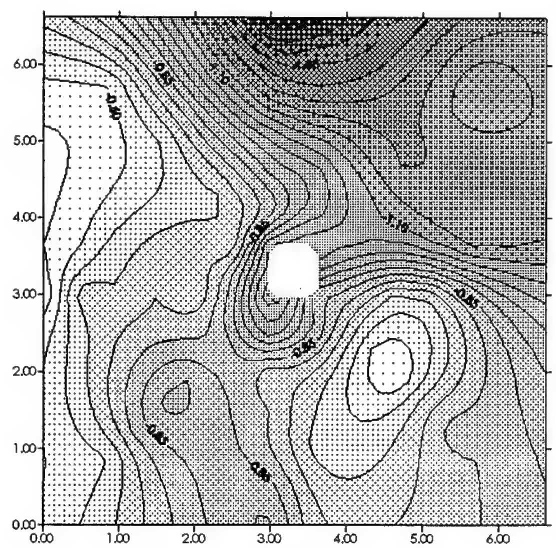


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot



Contour Plot #4

Raw Survey Data

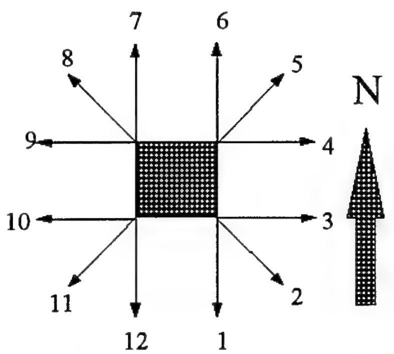
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	0.86	0.88	0.74	0.70	0.68	0.73	0.76
2	0.86	0.77	0.60	0.55	0.73	0.82	0.80
3	0.86	0.81	0.70	0.72	0.85	0.96	1.02
4	1.10	1.05	1.03	1.08	1.15	1.15	1.14
5	1.10	1.05	1.10	1.20	1.20	1.15	1.10
6	1.10	0.97	0.98	1.12	1.28	1.36	1.52
7	1.07	0.82	0.91	1.03	1.23	1.36	1.56
8	1.07	0.75	0.70	0.70	0.66	0.65	0.60
9	1.07	0.72	0.75	0.72	0.68	0.60	0.55
10	1.15	0.88	0.70	0.75	0.70	0.73	0.50
11	1.15	0.95	0.80	0.90	0.91	0.82	0.65
12	1.15	1.03	0.77	0.80	0.80	0.87	0.91

Manual Survey
Number 05

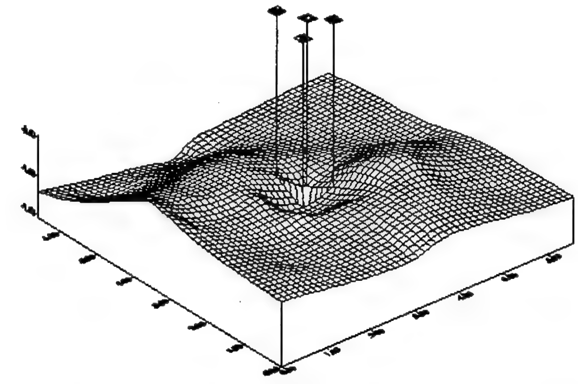
19 August 1995 0800

Survey Crew: Wayne Walker
Carl Walters

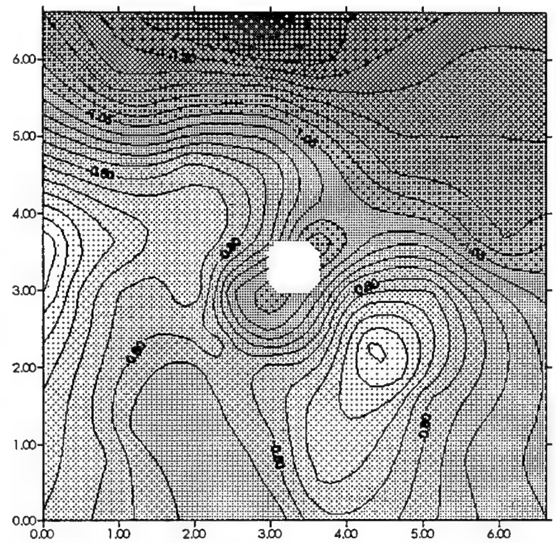


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot #5



Contour Plot #5

Raw Survey Data

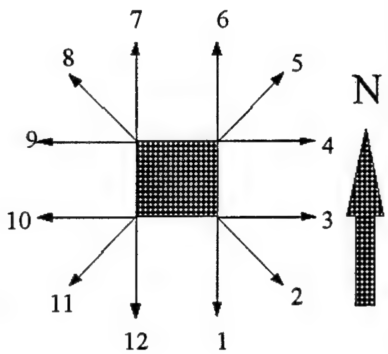
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	0.99	0.88	0.75	0.68	0.67	0.70	0.77
2	0.99	0.72	0.54	0.56	0.80	0.85	0.93
3	0.99	0.78	0.75	0.75	0.88	0.97	1.02
4	1.16	1.03	0.96	0.97	1.08	1.15	1.10
5	1.16	1.02	1.08	1.18	1.20	1.22	1.21
6	1.16	1.00	1.00	1.10	1.25	1.40	1.35
7	0.90	0.87	0.87	1.00	1.18	1.40	1.55
8	0.90	0.78	0.75	0.80	1.00	1.15	1.23
9	0.90	0.78	0.71	0.71	0.65	0.60	0.45
10	1.08	1.00	0.70	0.78	0.75	0.66	0.49
11	1.08	1.00	0.77	0.88	0.89	0.87	0.75
12	1.08	1.02	0.78	0.78	0.82	0.84	0.90

Manual Survey
Number 06

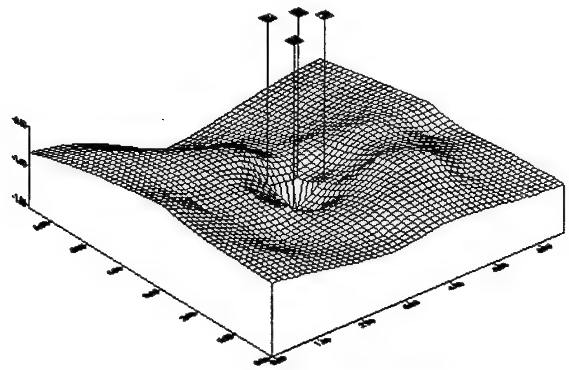
19 August 1995 1700

Survey Crew: Wayne Walker
Pete Kummer

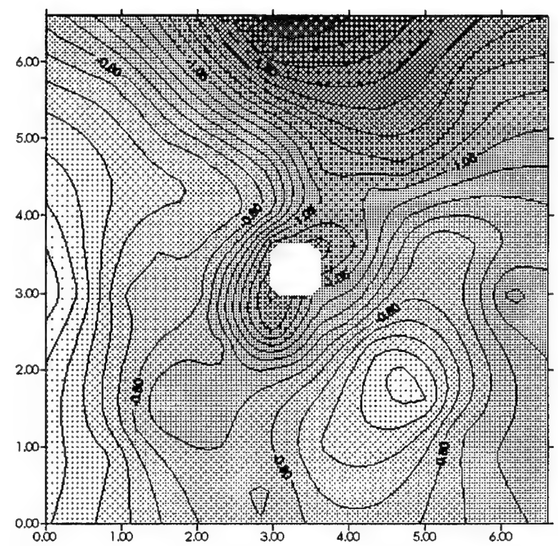


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot #6



Contour Plot #6

Raw Survey Data

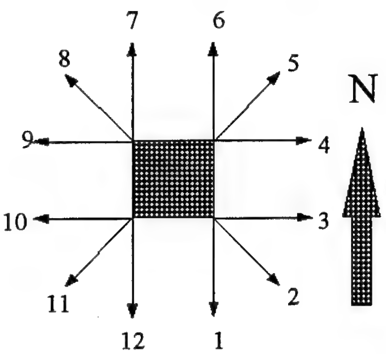
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.02	0.92	0.81	0.73	0.70	0.74	0.78
2	1.02	0.92	0.67	0.58	0.60	0.83	0.89
3	1.02	0.98	0.83	0.82	0.87	1.02	0.98
4	1.18	1.10	0.92	0.80	0.84	0.91	0.91
5	1.18	1.08	1.04	1.15	1.18	1.17	1.13
6	1.18	1.05	1.10	1.15	1.28	1.38	1.50
7	1.14	0.83	0.88	1.02	1.22	1.38	1.53
8	1.14	0.77	0.72	0.72	0.76	0.75	0.75
9	1.14	0.85	0.74	0.75	0.70	0.60	0.50
10	1.22	1.01	0.77	0.77	0.75	0.57	0.46
11	1.22	1.08	0.82	0.88	0.90	0.81	0.65
12	1.22	1.17	0.89	0.81	0.80	0.85	0.85

Manual Survey Number 07

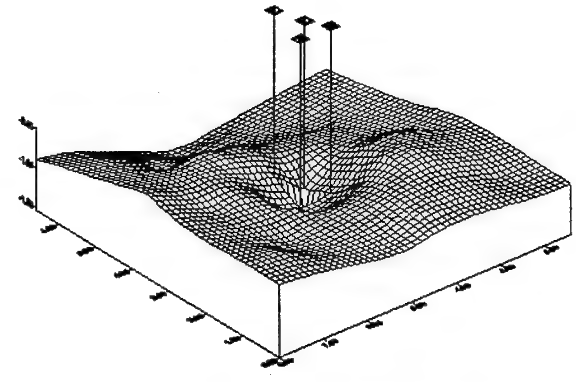
20 August 1995 0900

Survey Crew: Wayne Walker
Pete Kummer

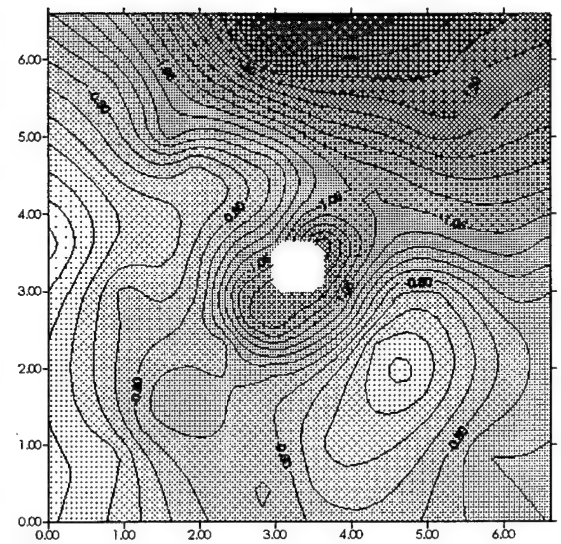


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot #7



Contour Plot #7

Raw Survey Data

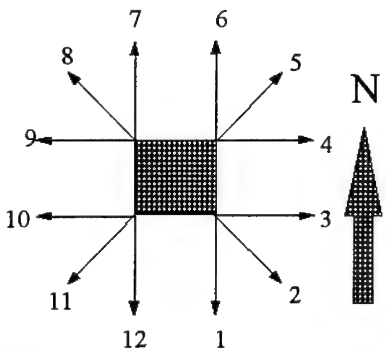
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.18	1.00	0.80	0.73	0.70	0.72	0.78
2	1.18	0.94	0.64	0.58	0.67	0.78	0.90
3	1.18	0.95	0.76	0.75	0.84	0.93	0.90
4	1.31	1.11	0.98	0.97	1.02	1.03	0.98
5	1.31	1.07	1.05	1.13	1.26	1.32	1.28
6	1.31	1.05	1.02	1.17	1.31	1.41	1.55
7	1.00	0.88	0.87	1.06	1.26	1.48	1.52
8	1.00	0.84	0.73	0.75	0.98	0.89	0.85
9	1.00	0.92	0.77	0.66	0.67	0.58	0.47
10	1.18	1.10	0.80	0.73	0.77	0.65	0.55
11	1.18	1.15	0.82	0.86	0.90	0.81	0.63
12	1.18	1.16	0.87	0.80	0.81	0.85	0.85

Manual Survey Number 08

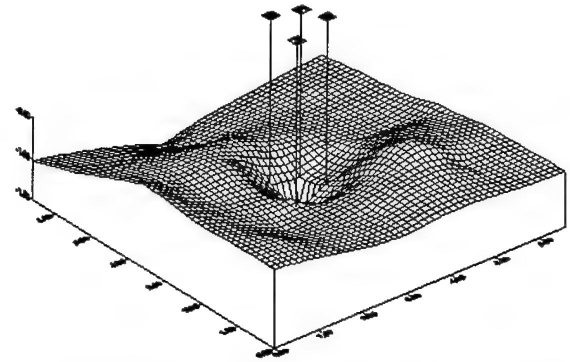
20 August 1995 1830

Survey Crew: Wayne Walker
Pete Kummer

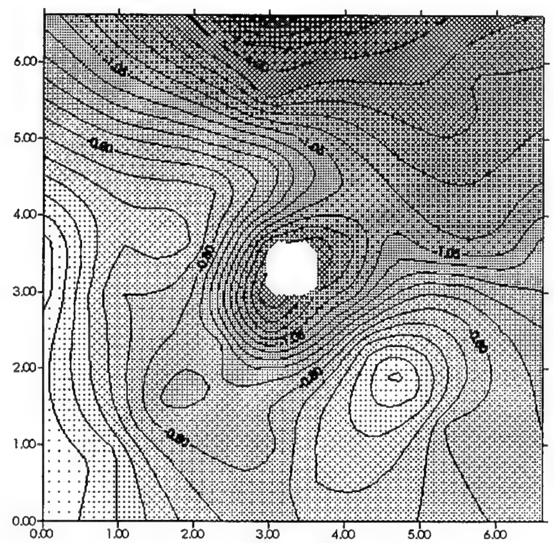


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot #8



Contour Plot #8

Raw Survey Data

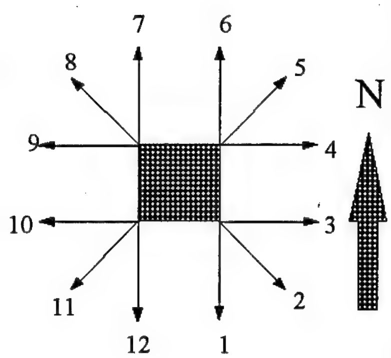
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.15	1.03	0.82	0.72	0.70	0.70	0.74
2	1.15	0.96	0.68	0.53	0.62	0.82	0.82
3	1.15	1.08	0.92	0.85	0.87	0.93	0.95
4	1.24	1.16	1.02	1.07	1.09	1.08	0.98
5	1.24	1.10	1.06	1.14	1.19	1.24	1.19
6	1.24	1.06	1.00	1.09	1.23	1.31	1.43
7	1.20	0.92	0.87	1.04	1.29	1.31	1.52
8	1.20	0.88	0.75	0.80	0.88	0.96	1.01
9	1.20	0.92	0.70	0.68	0.70	0.60	0.47
10	1.31	1.06	0.80	0.75	0.75	0.62	0.47
11	1.31	1.10	0.81	0.86	0.86	0.75	0.57
12	1.31	1.18	0.89	0.80	0.82	0.78	0.78

Manual Survey
Number 09

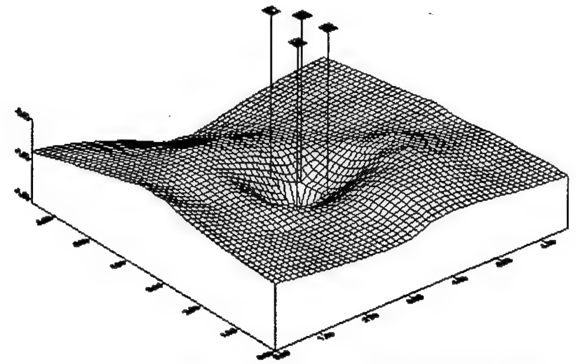
21 August 1995 0900

Survey Crew: Wayne Walker
Pete Kummer

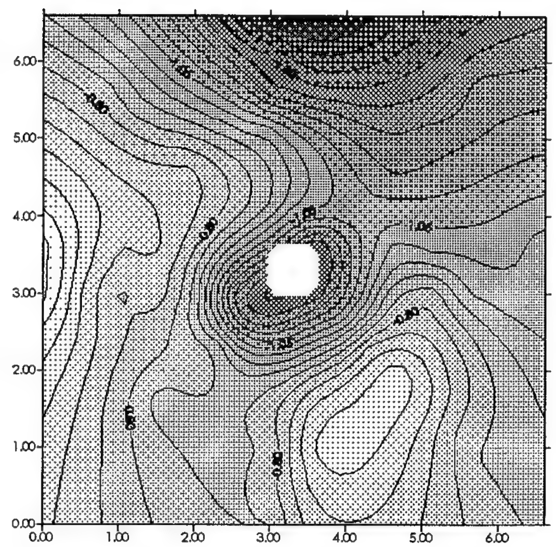


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot #9



Contour Plot #9

Raw Survey Data

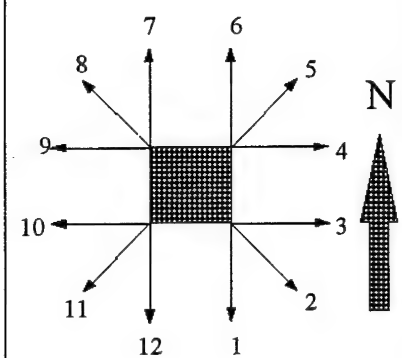
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.28	1.05	0.82	0.68	0.64	0.68	0.72
2	1.28	1.05	0.74	0.62	0.68	0.79	0.85
3	1.28	1.10	0.87	0.82	0.95	0.98	1.00
4	1.31	1.13	0.99	1.02	1.02	1.02	0.97
5	1.31	1.09	1.10	1.17	1.18	1.21	1.19
6	1.31	1.04	1.02	1.10	1.28	1.40	1.54
7	1.10	0.91	0.90	0.98	1.23	1.30	1.50
8	1.10	0.87	0.77	0.75	0.83	0.87	0.85
9	1.10	0.95	0.79	0.69	0.70	0.61	0.48
10	1.32	1.20	0.86	0.72	0.76	0.65	0.48
11	1.32	1.20	0.86	0.82	0.88	0.81	0.76
12	1.32	1.17	0.91	0.82	0.84	0.82	0.85

Manual Survey
Number 10

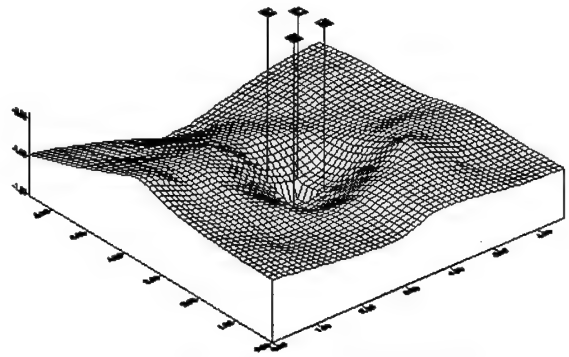
21August 1995 1900

Survey Crew: Wayne Walker
Bob Yardley

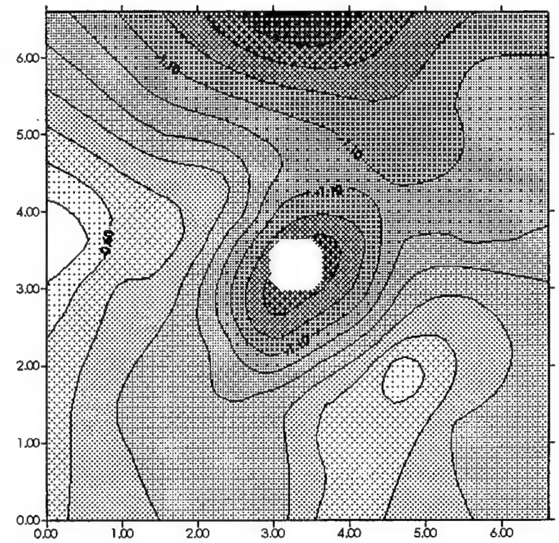


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot #10



Contour Plot #10

Raw Survey Data

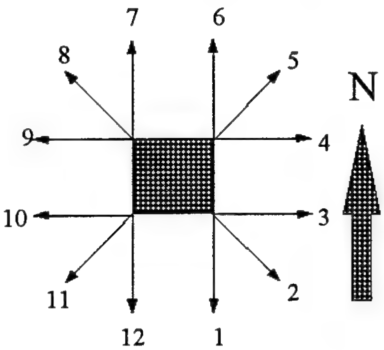
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.31	1.12	0.88	0.71	0.69	0.71	0.68
2	1.31	1.09	0.82	0.52	0.64	0.81	0.86
3	1.31	1.18	0.92	0.82	0.82	0.86	0.89
4	1.34	1.25	1.01	0.98	1.01	1.00	0.98
5	1.34	1.18	1.08	1.15	1.17	1.10	1.06
6	1.34	1.15	1.01	1.10	1.21	1.39	1.50
7	1.22	1.07	0.98	1.05	1.18	1.35	1.52
8	1.22	0.91	0.75	0.82	0.91	0.95	0.95
9	1.22	1.00	0.75	0.65	0.65	0.48	0.40
10	1.35	1.13	0.89	0.72	0.72	0.63	0.51
11	1.35	1.20	0.93	0.87	0.89	0.87	0.75
12	1.35	1.28	1.05	0.83	0.84	0.85	0.85

Manual Survey
Number 11

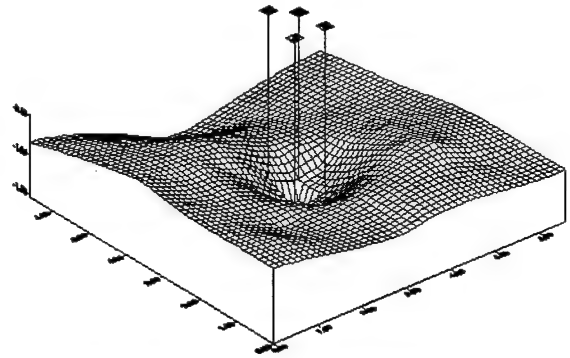
22 August 1995 0930

Survey Crew: Wayne Walker
Pete Kummer

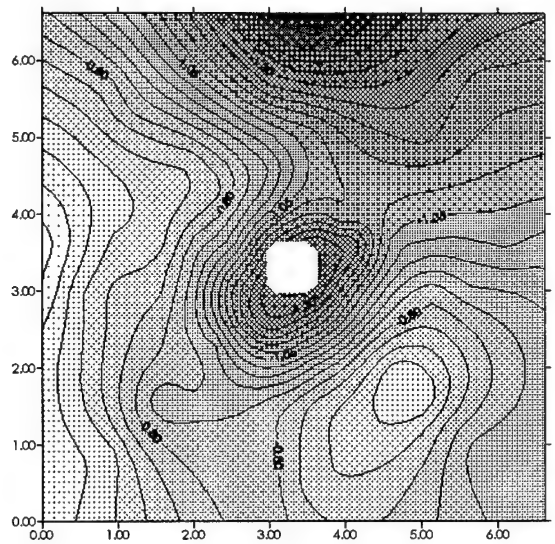


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot #11



Contour Plot #11

Raw Survey Data

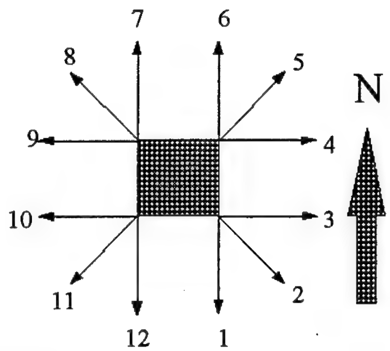
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.35	1.14	0.88	0.73	0.72	0.71	0.76
2	1.35	1.07	0.79	0.61	0.61	0.78	0.88
3	1.35	1.11	0.91	0.82	0.89	0.90	0.92
4	1.35	1.30	1.03	0.99	0.99	1.01	0.98
5	1.35	1.10	1.12	1.15	1.22	1.20	1.18
6	1.35	1.12	1.07	1.10	1.27	1.45	1.55
7	1.20	0.97	0.90	1.02	1.23	1.37	1.52
8	1.20	0.90	0.73	0.71	0.77	0.82	0.78
9	1.20	0.92	0.82	0.67	0.67	0.58	0.47
10	1.34	1.15	0.88	0.73	0.72	0.64	0.50
11	1.34	1.20	0.90	0.82	0.89	0.78	0.62
12	1.34	1.27	1.00	0.82	0.82	0.82	0.83

Manual Survey Number 12

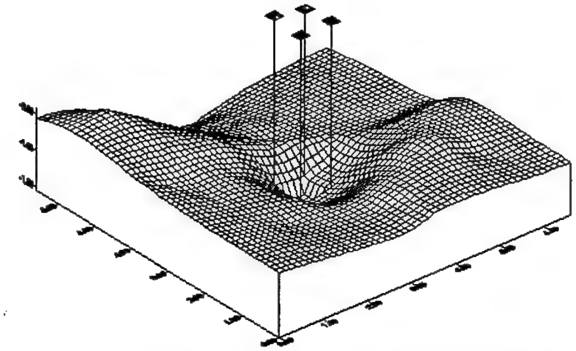
22 August 1995 1600

Survey Crew: Wayne Walker
Pete Kummer

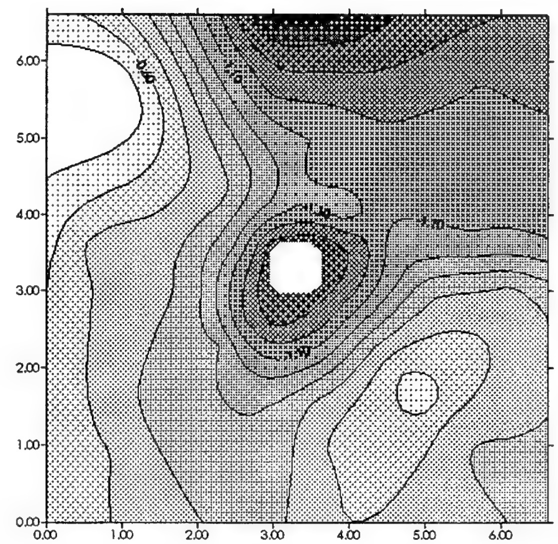


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot #12



Contour Plot #12

Raw Survey Data

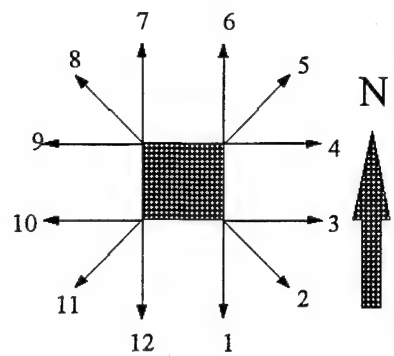
In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.34	1.20	0.96	0.76	0.71	0.73	0.71
2	1.34	1.10	0.81	0.60	0.56	0.75	0.82
3	1.34	1.20	0.98	0.82	0.80	0.77	0.85
4	1.39	1.27	1.05	1.06	1.07	1.05	1.09
5	1.39	1.07	1.13	1.17	1.17	1.19	1.20
6	1.39	1.07	1.15	1.10	1.24	1.35	1.55
7	1.35	1.02	0.98	1.07	1.22	1.34	1.54
8	1.35	0.97	0.76	0.71	0.61	0.48	0.40
9	1.35	1.00	0.85	0.75	0.76	0.70	0.57
10	1.38	1.15	0.87	0.77	0.79	0.67	0.60
11	1.38	1.21	0.90	0.86	0.87	0.78	0.70
12	1.38	1.29	1.05	0.89	0.87	0.84	0.83

Manual Survey
Number 13

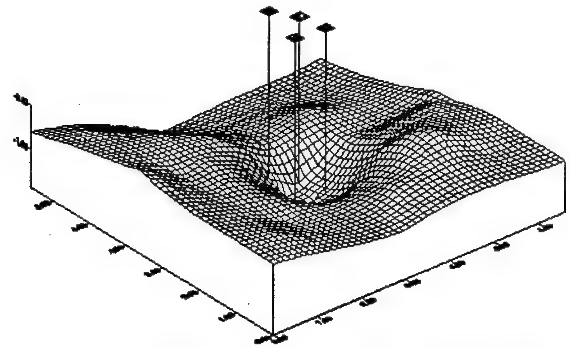
23August 1995 0900

Survey Crew: Wayne Walker
Frank Walker

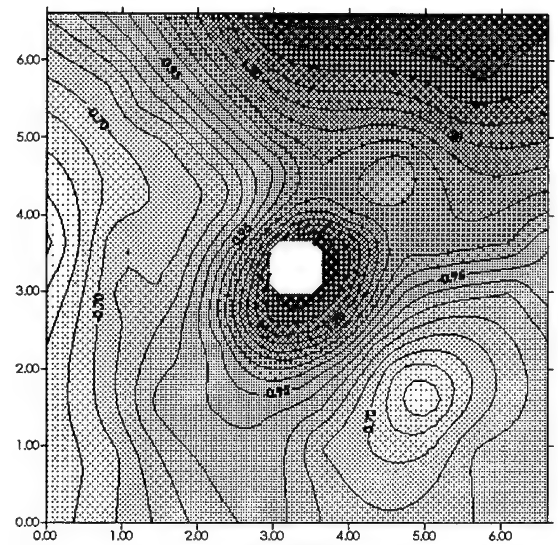


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot #13



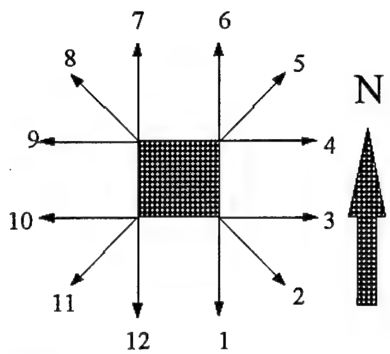
Contour Plot #13

Raw Survey Data							In Meters
Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.37	1.25	0.97	0.86	0.75	0.79	0.80
2	1.37	1.18	0.85	0.63	0.55	0.72	0.82
3	1.37	1.21	0.98	0.90	0.87	0.85	0.93
4	1.42	1.27	1.07	1.09	1.07	1.05	0.95
5	1.42	1.12	1.02	1.02	1.15	1.28	1.35
6	1.42	1.12	1.10	1.15	1.25	1.34	1.43
7	1.24	1.00	0.95	1.10	1.20	1.30	1.43
8	1.24	0.90	0.77	0.77	0.76	0.80	0.76
9	1.24	0.96	0.80	0.70	0.76	0.62	0.48
10	1.35	1.10	0.87	0.75	0.77	0.65	0.55
11	1.35	1.20	0.94	0.87	0.89	0.79	0.68
12	1.35	1.28	1.05	0.91	0.88	0.87	0.87

Manual Survey Number 14

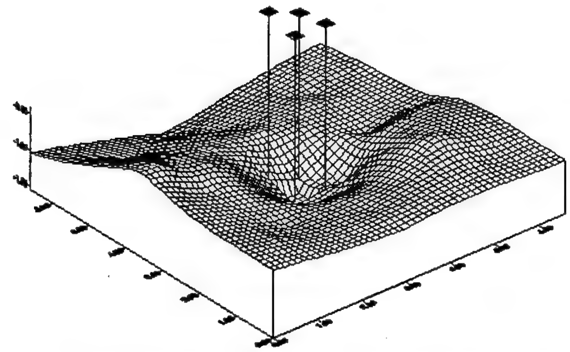
24 August 1995 0810

Survey Crew: Wayne Walker
Frank Walker

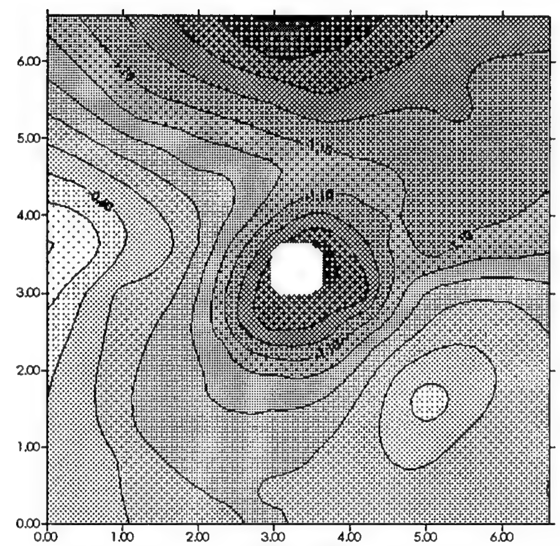


Key

Bent #15 Outbourd Pile
South Side of South Span



Surface Plot #14



Contour Plot #14

Raw Survey Data

In Meters

Survey Line	0 M	.5 M	1.0 M	1.5 M	2.0 M	2.5 M	3.0 M
1	1.37	1.27	1.01	0.88	0.80	0.77	0.77
2	1.37	1.18	0.90	0.68	0.54	0.67	0.80
3	1.37	1.40	1.04	0.86	0.82	0.82	0.87
4	1.44	1.25	1.06	1.17	1.06	1.06	1.02
5	1.44	1.17	1.07	1.11	1.11	1.24	1.16
6	1.44	1.17	1.03	1.17	1.31	1.39	1.52
7	1.28	1.05	0.98	1.12	1.24	1.42	1.55
8	1.28	0.98	0.85	0.92	0.95	1.05	1.05
9	1.28	1.05	0.80	0.65	0.60	0.42	0.39
10	1.39	1.18	0.90	0.75	0.73	0.60	0.46
11	1.39	1.27	0.97	0.88	0.90	0.81	0.69
12	1.39	1.30	1.01	0.90	0.87	0.78	0.82

Appendix B

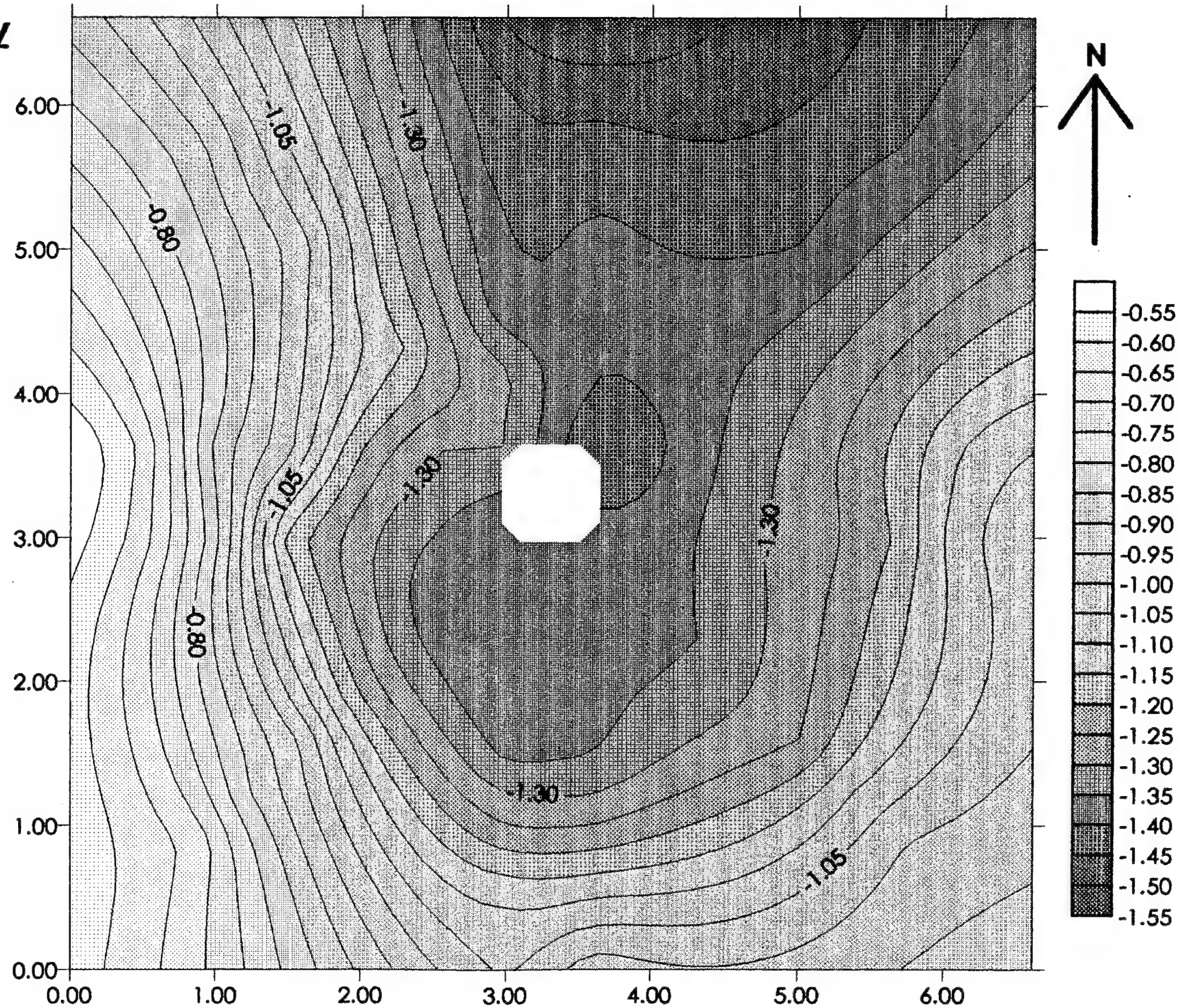
The following pages are presented to show larger surface and contour plots of the various surveys. The larger format allow the reader to see greater detail. The plots are in pairs with the contour plot followed by the surface plot.

Manual Survey

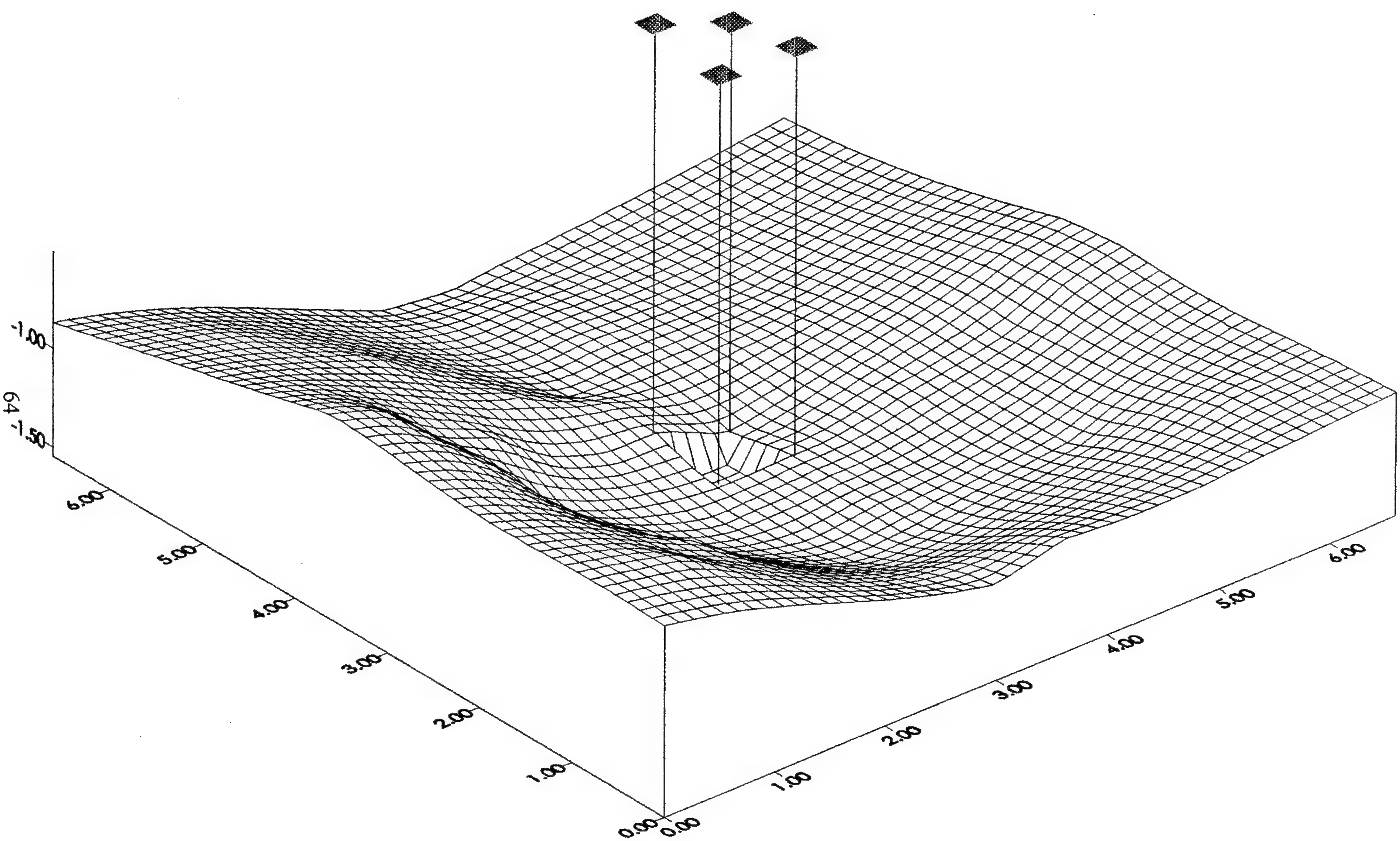
Number 01

16 August 1995

0900



Contour Plot #1



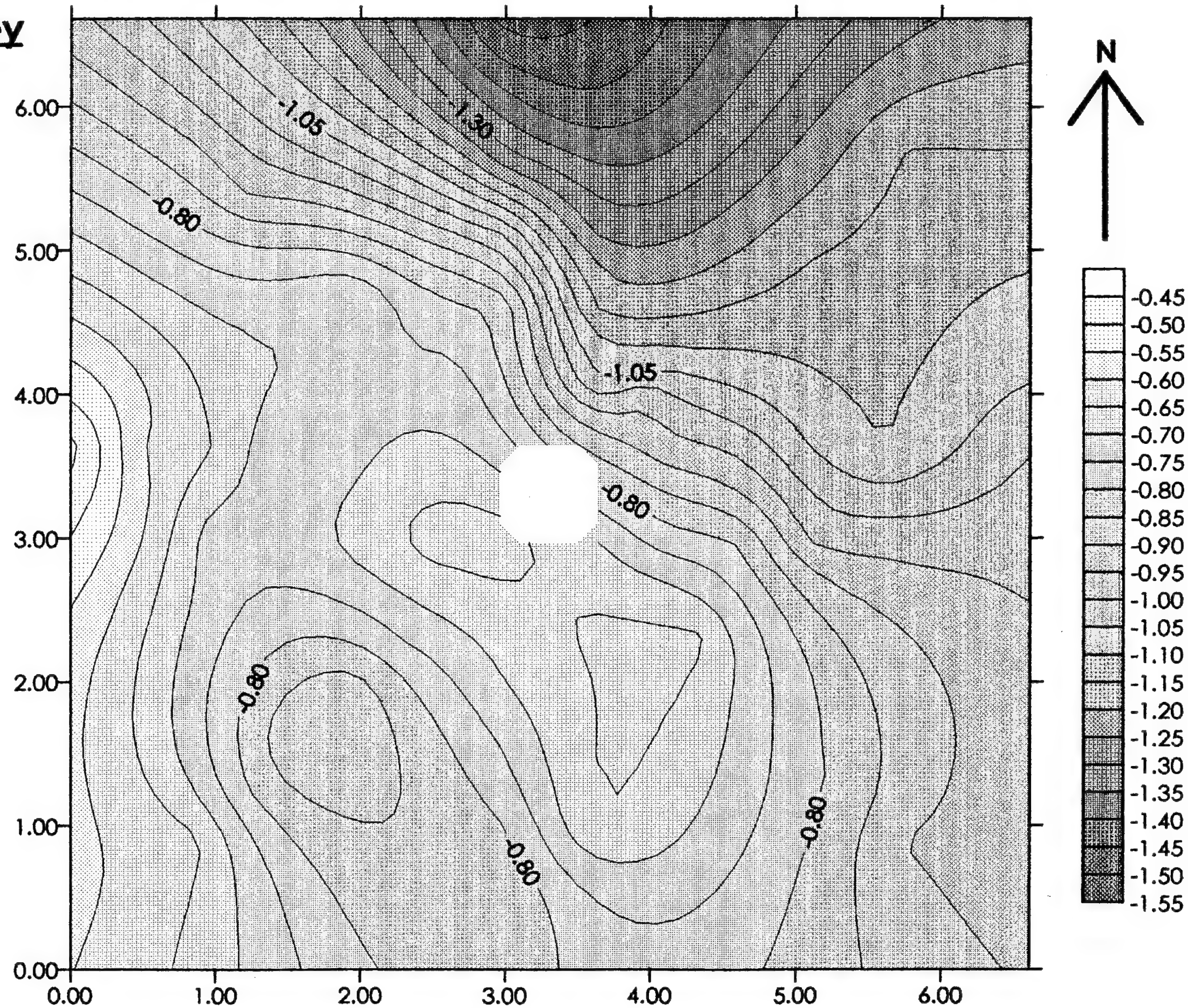
Surface Plot #1

Manual Survey

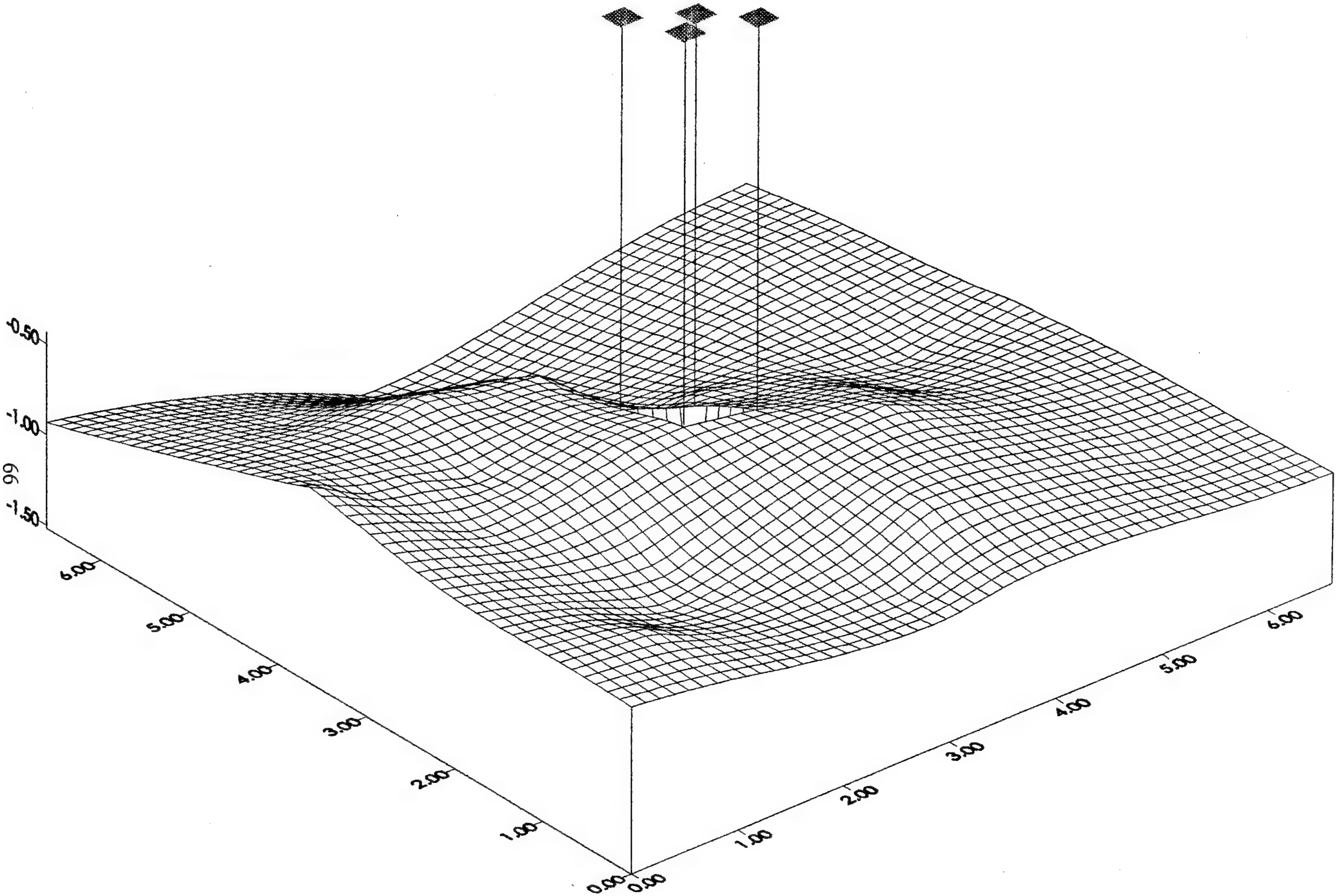
Number 02

16 August 1995

1845



Contour Plot #2



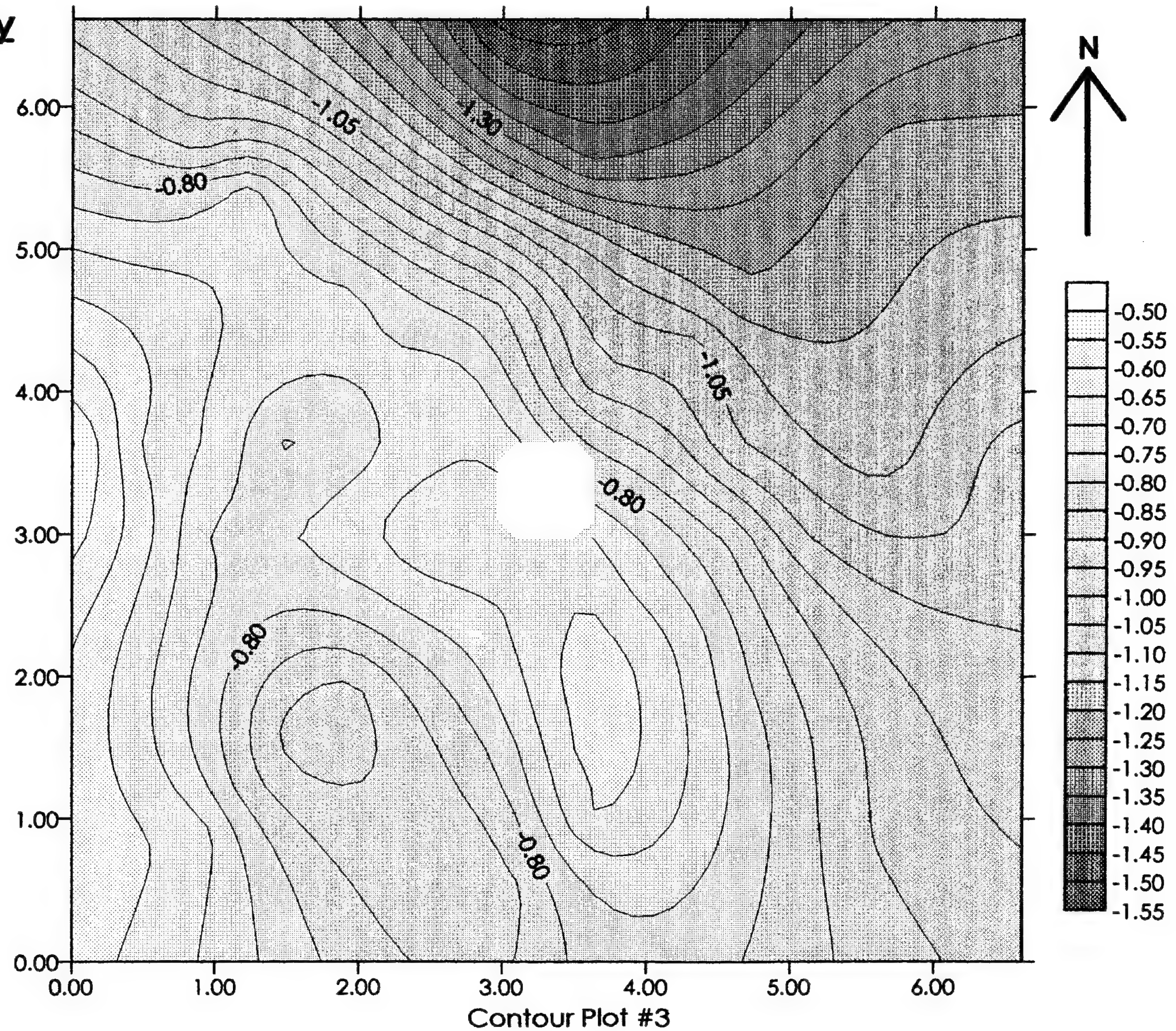
Surface Plot #2

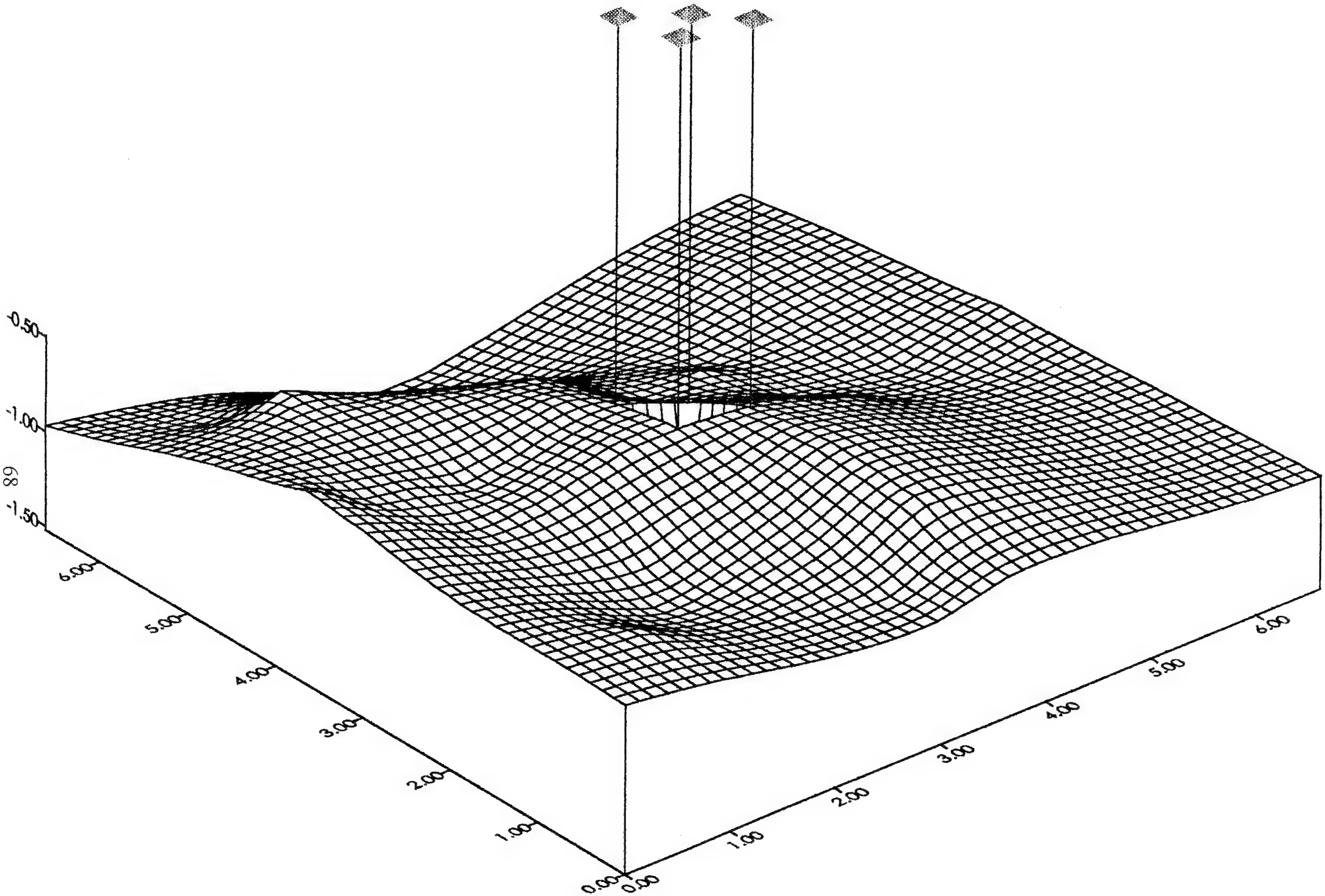
Manual Survey

Number 03

17 August 1995

0930





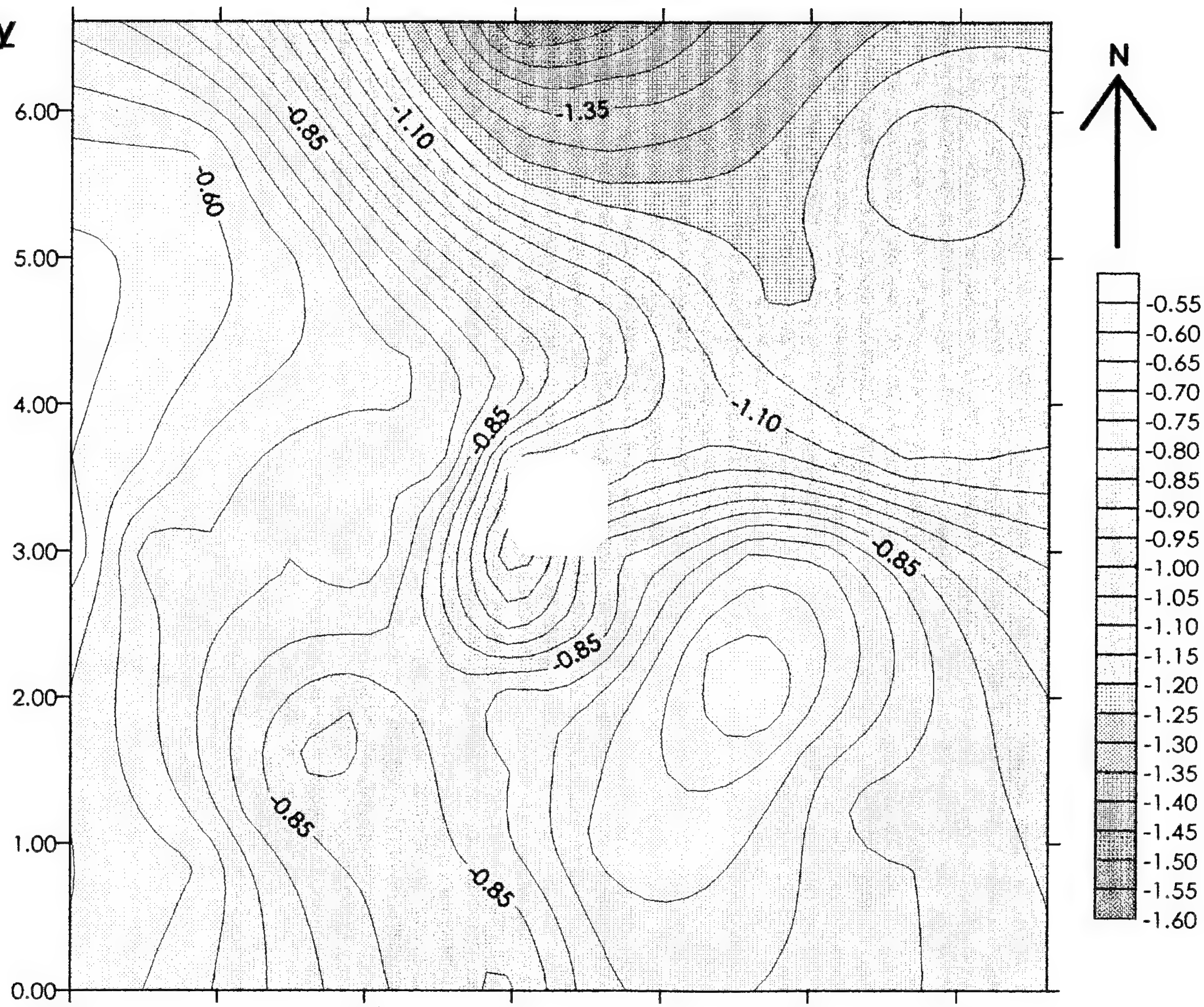
Surface Plot #3

Manual Survey

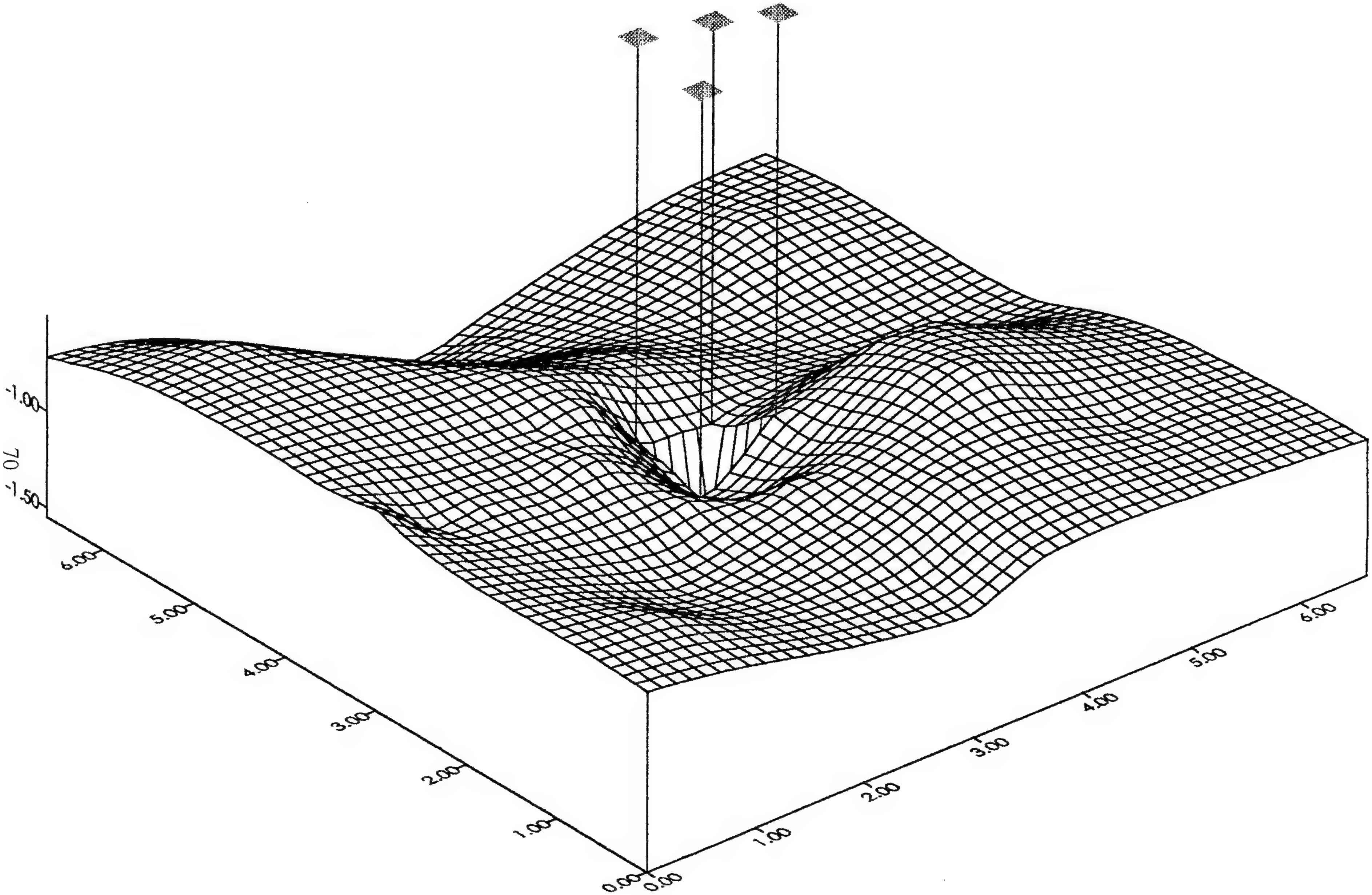
Number 04

18 August 1995

1830



Contour Plot #4



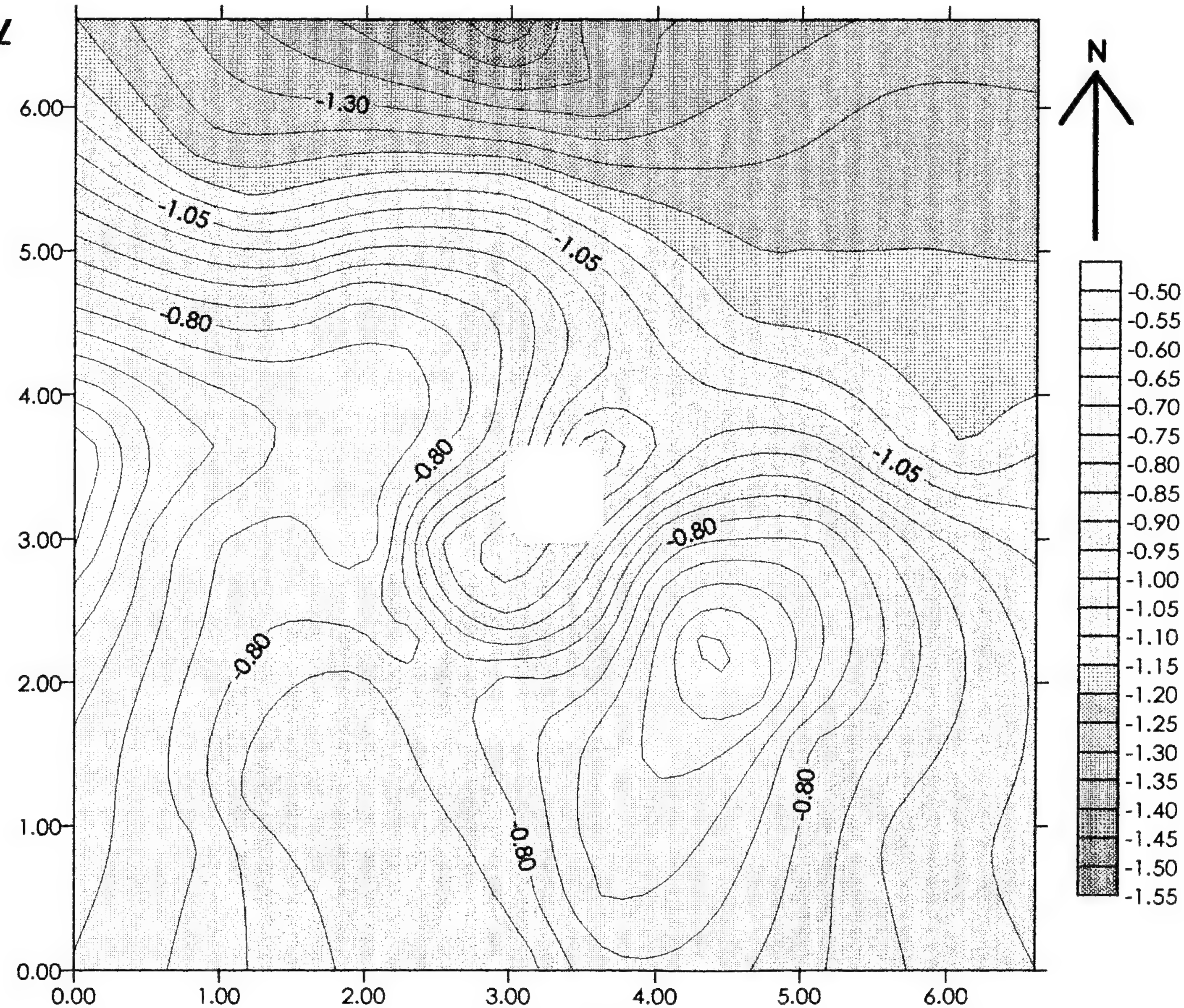
Surface Plot #4

Manual Survey

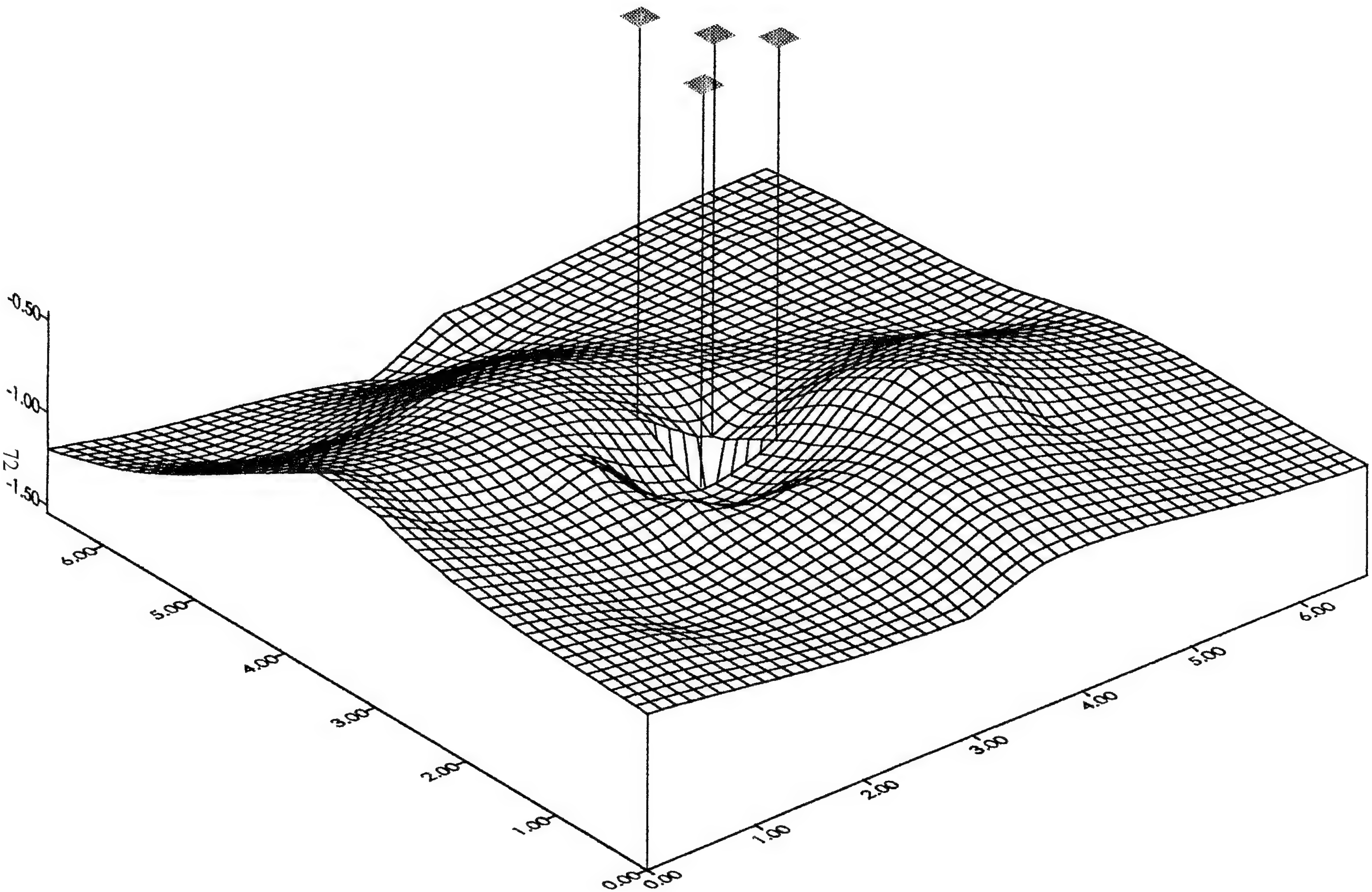
Number 05

19 August 1995

0800



Contour Plot #5



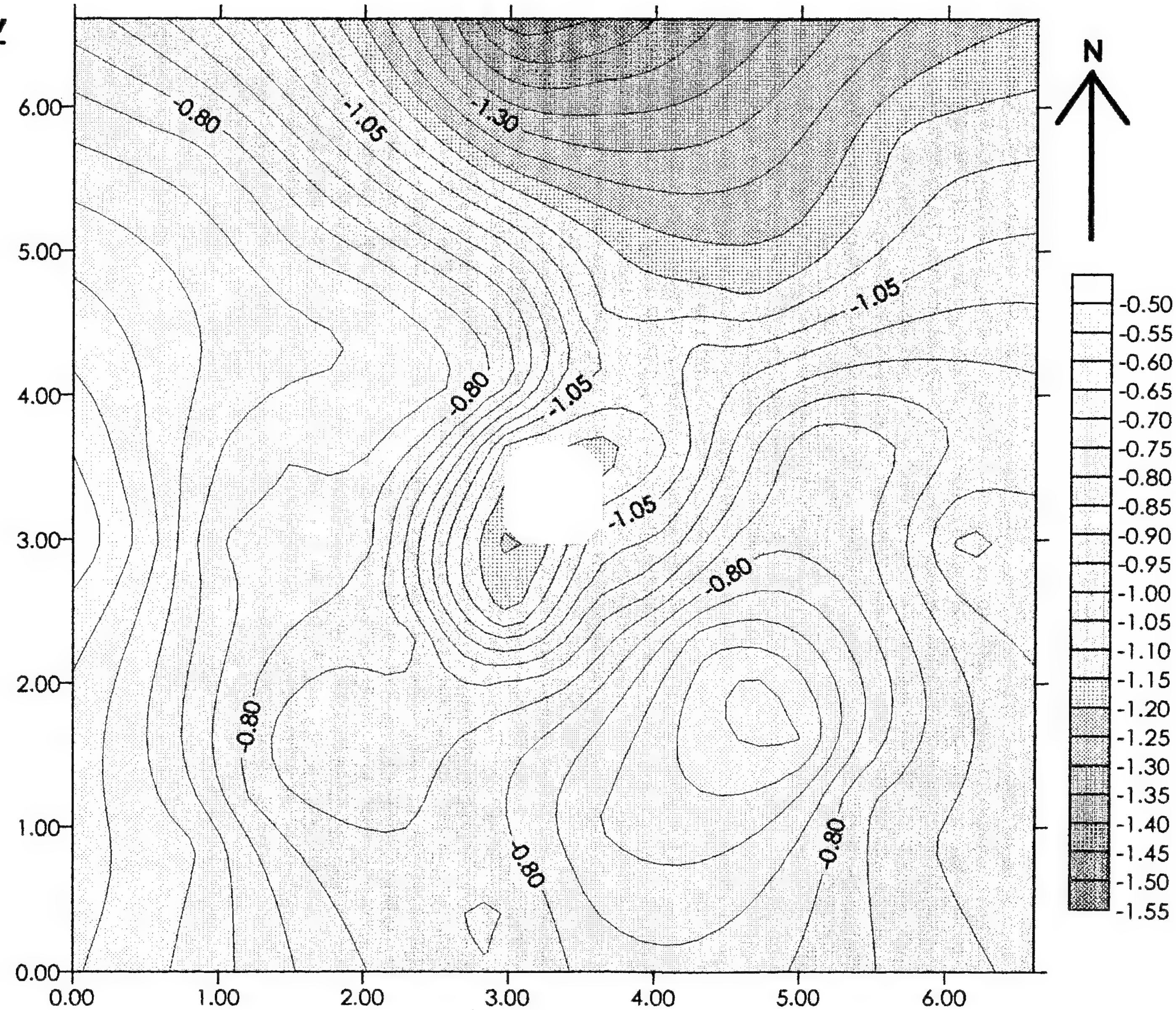
Surface Plot #5

Manual Survey

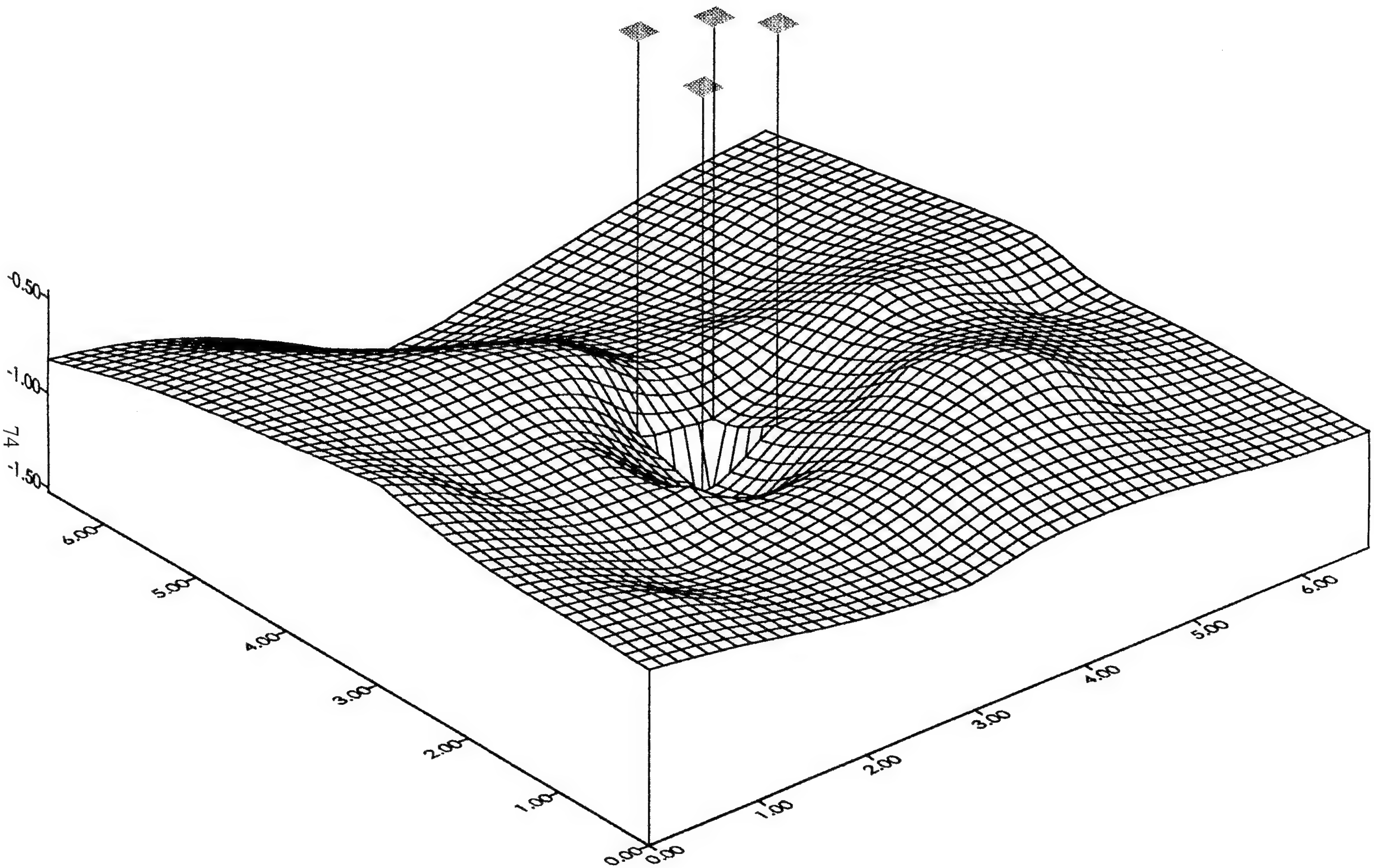
Number 06

19 August 1995

1700



Contour Plot #6



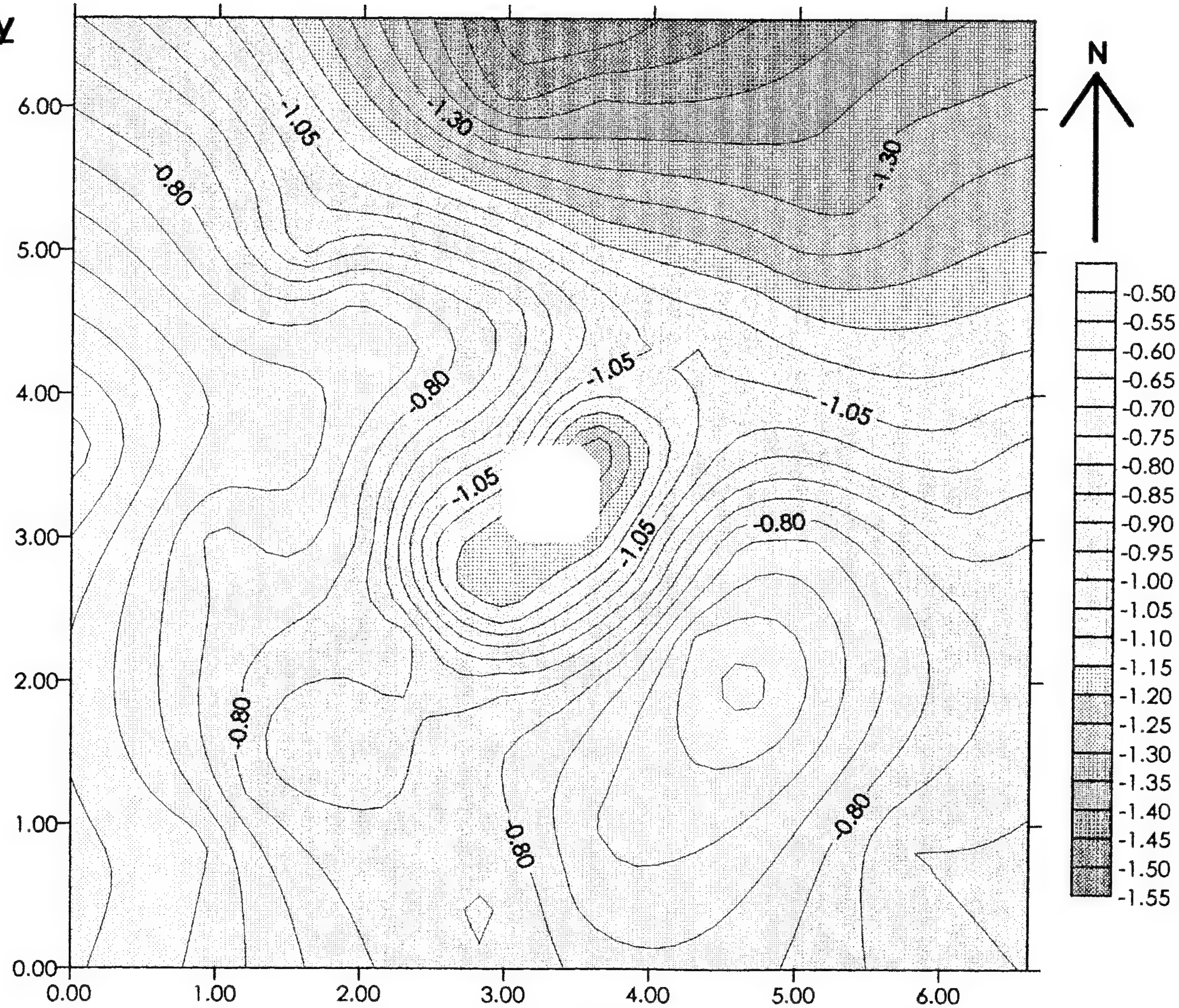
Surface Plot #6

Manual Survey

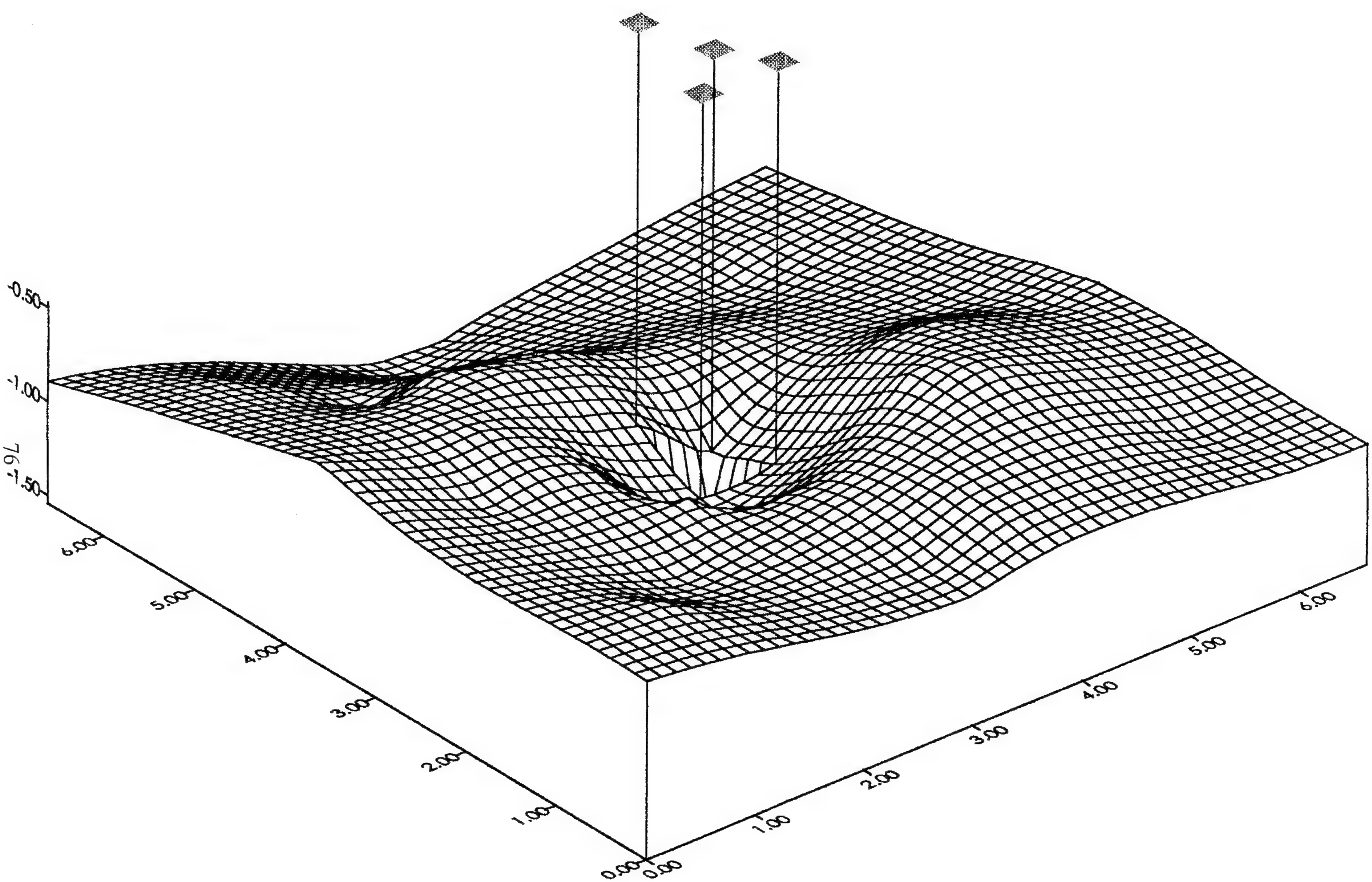
Number 07

20 August 1995

0900



Contour Plot #7



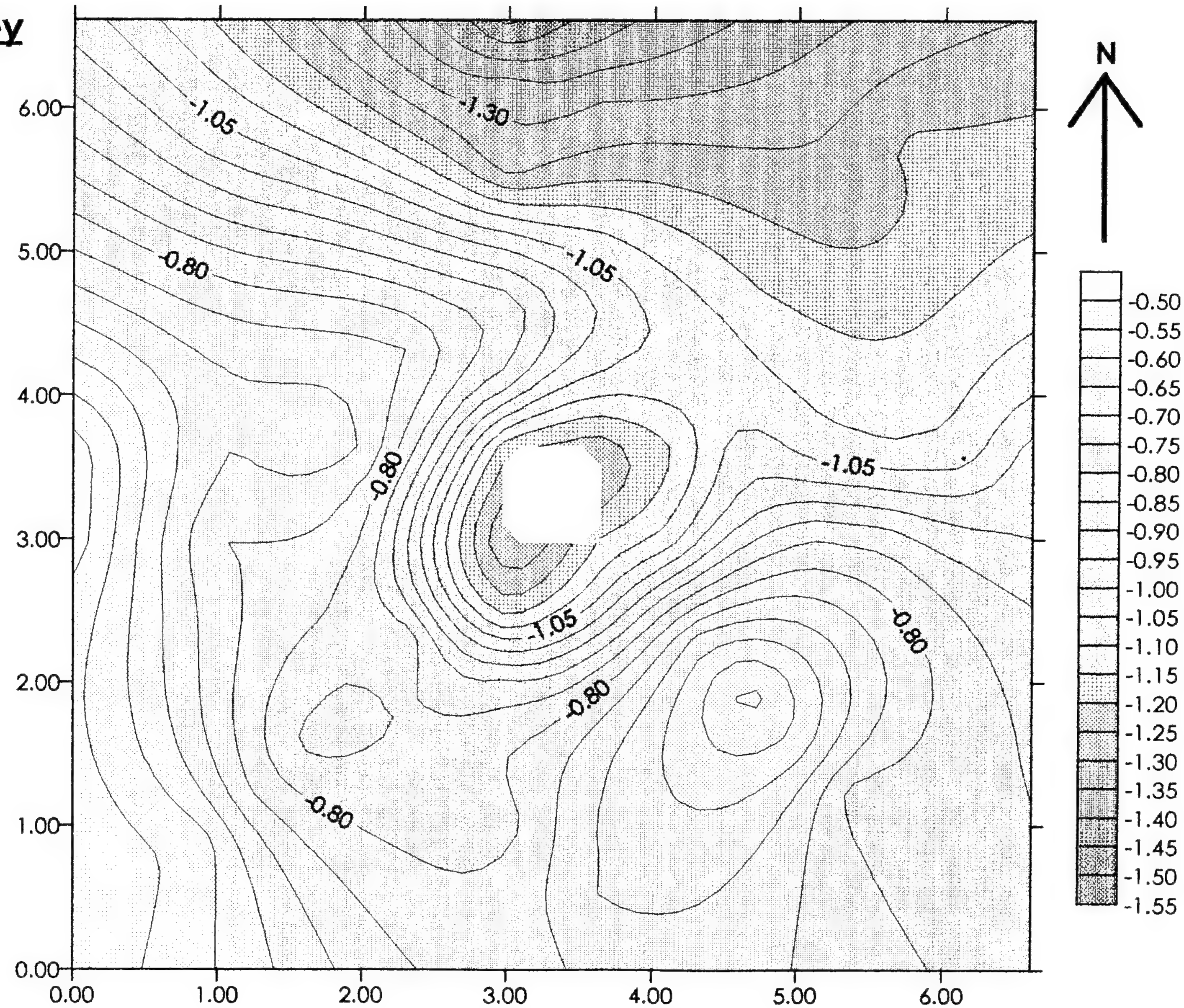
Surface Plot #7

Manual Survey

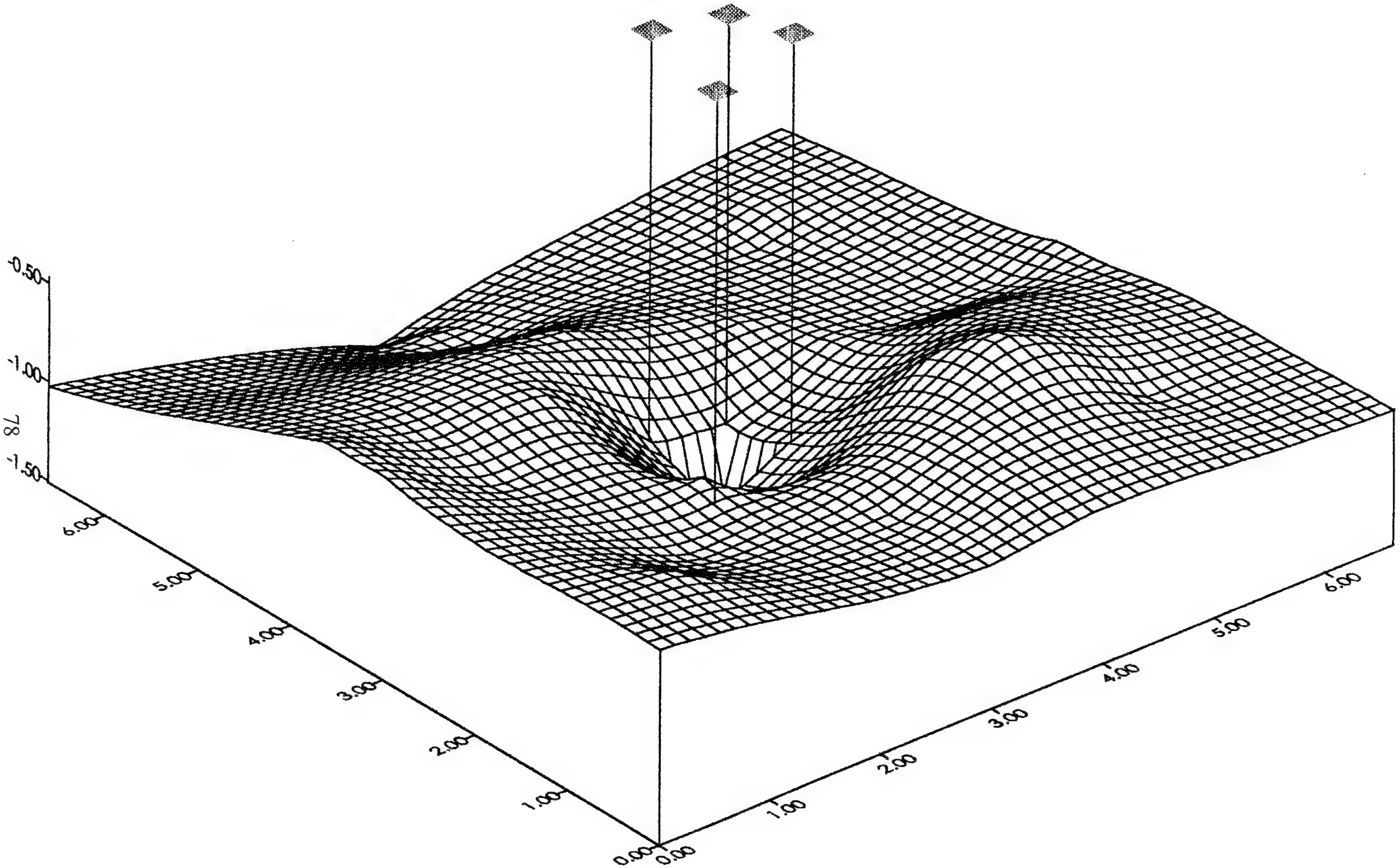
Number 08

20 August 1995

1830



Contour Plot #8



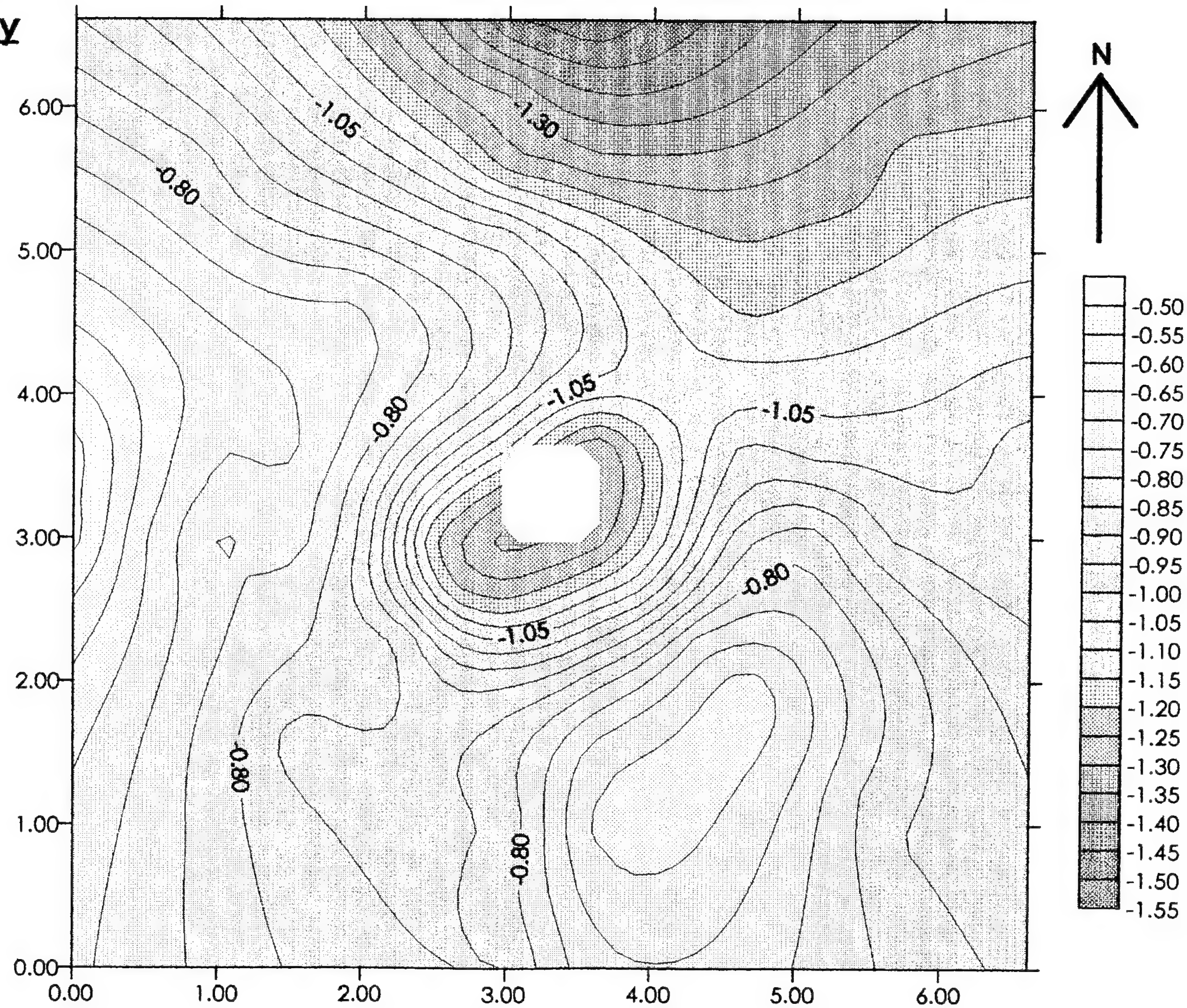
Surface Plot #8

Manual Survey

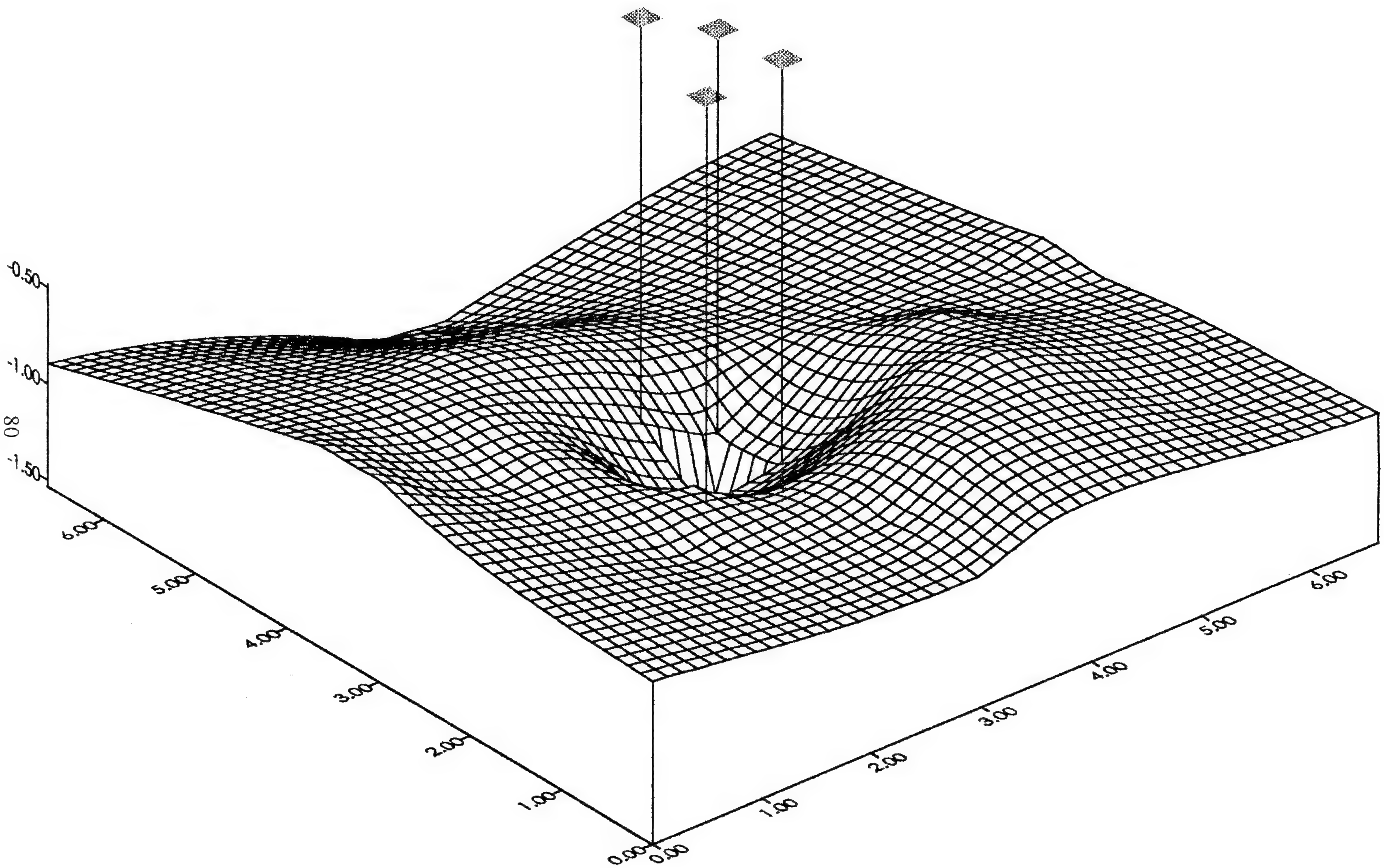
Number 09

21 August 1995

0900



Contour Plot #9



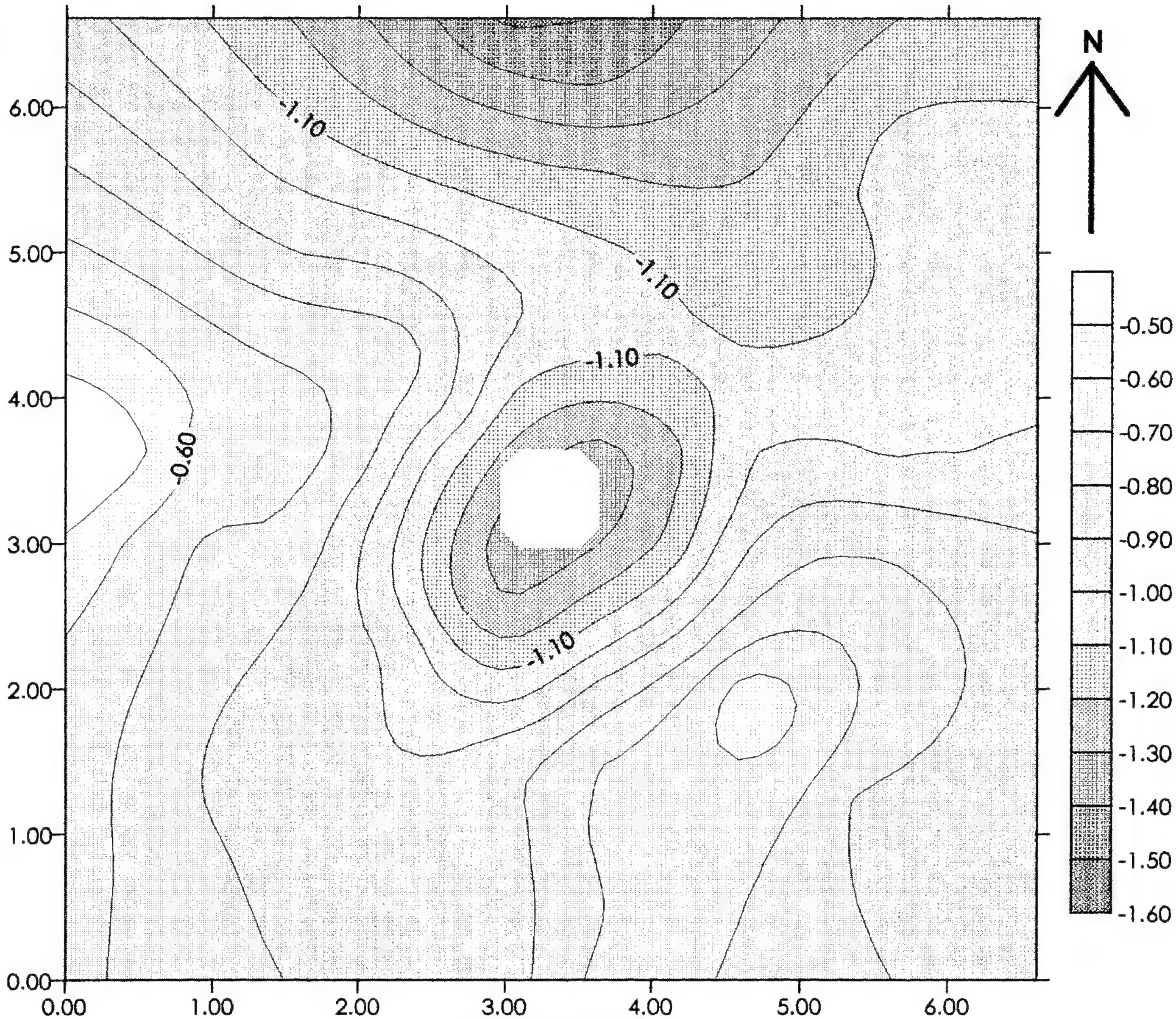
Surface Plot #9

Manual Survey

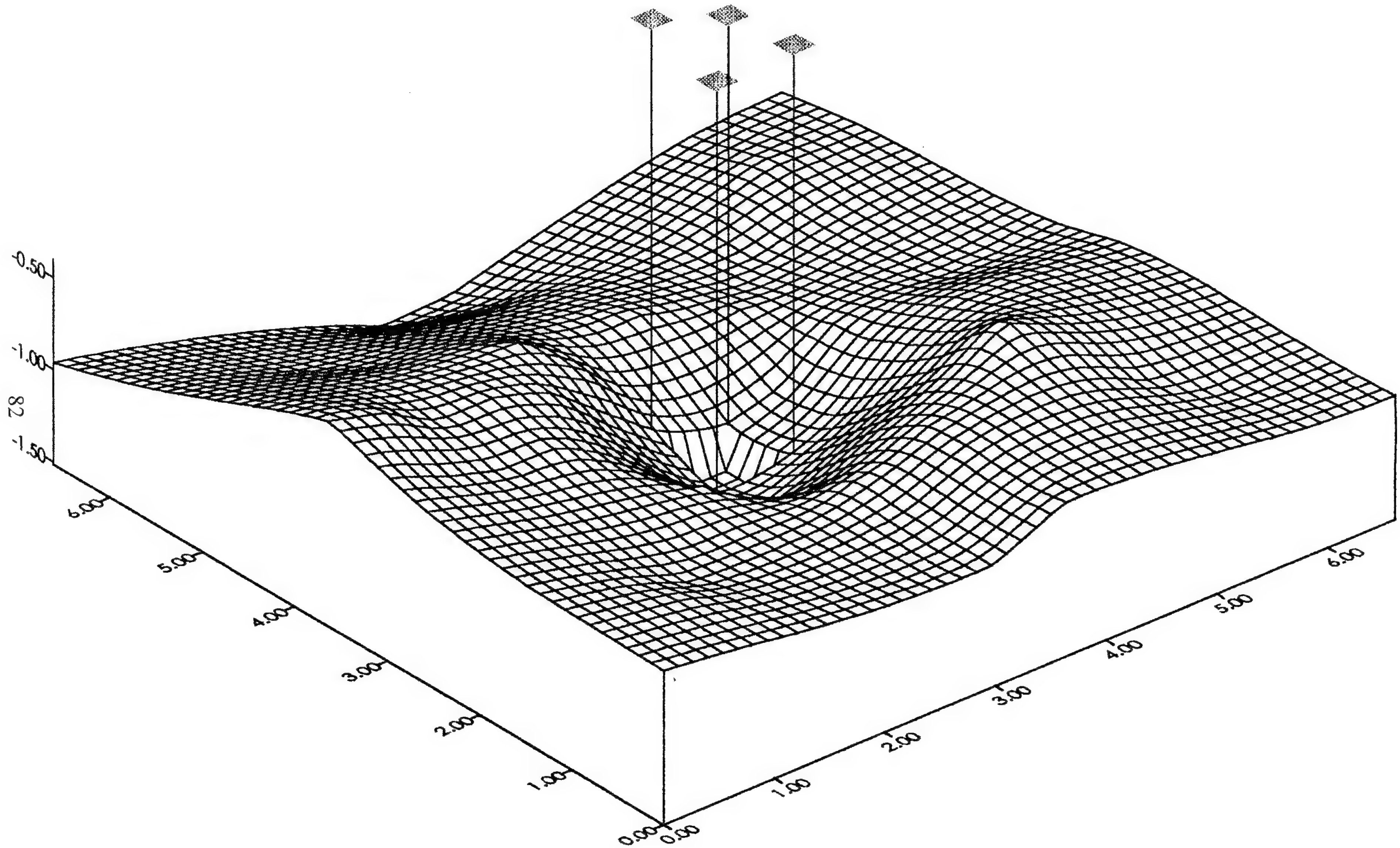
Number 10

21 August 1995

1900



Contour Plot #10



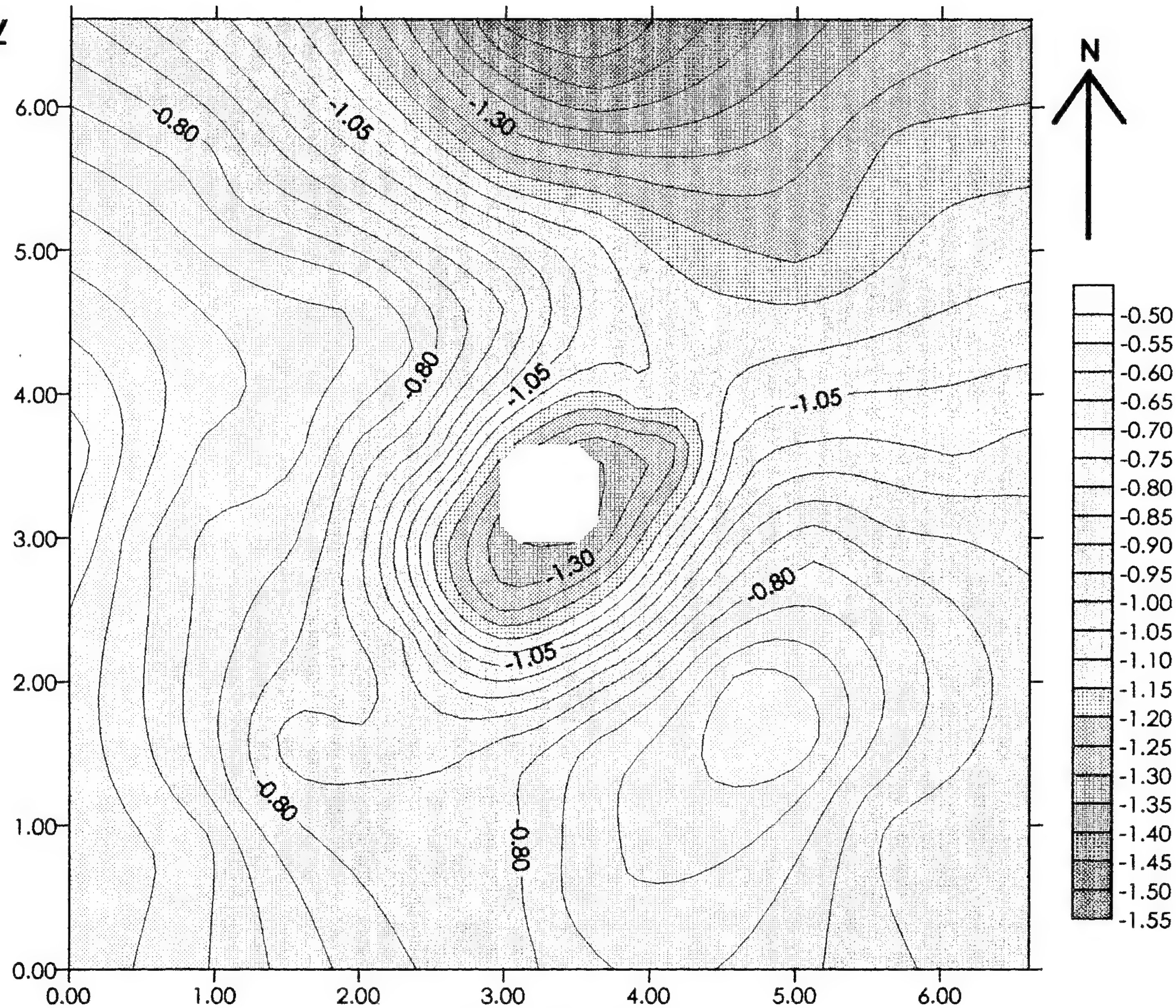
Surface Plot #10

Manual Survey

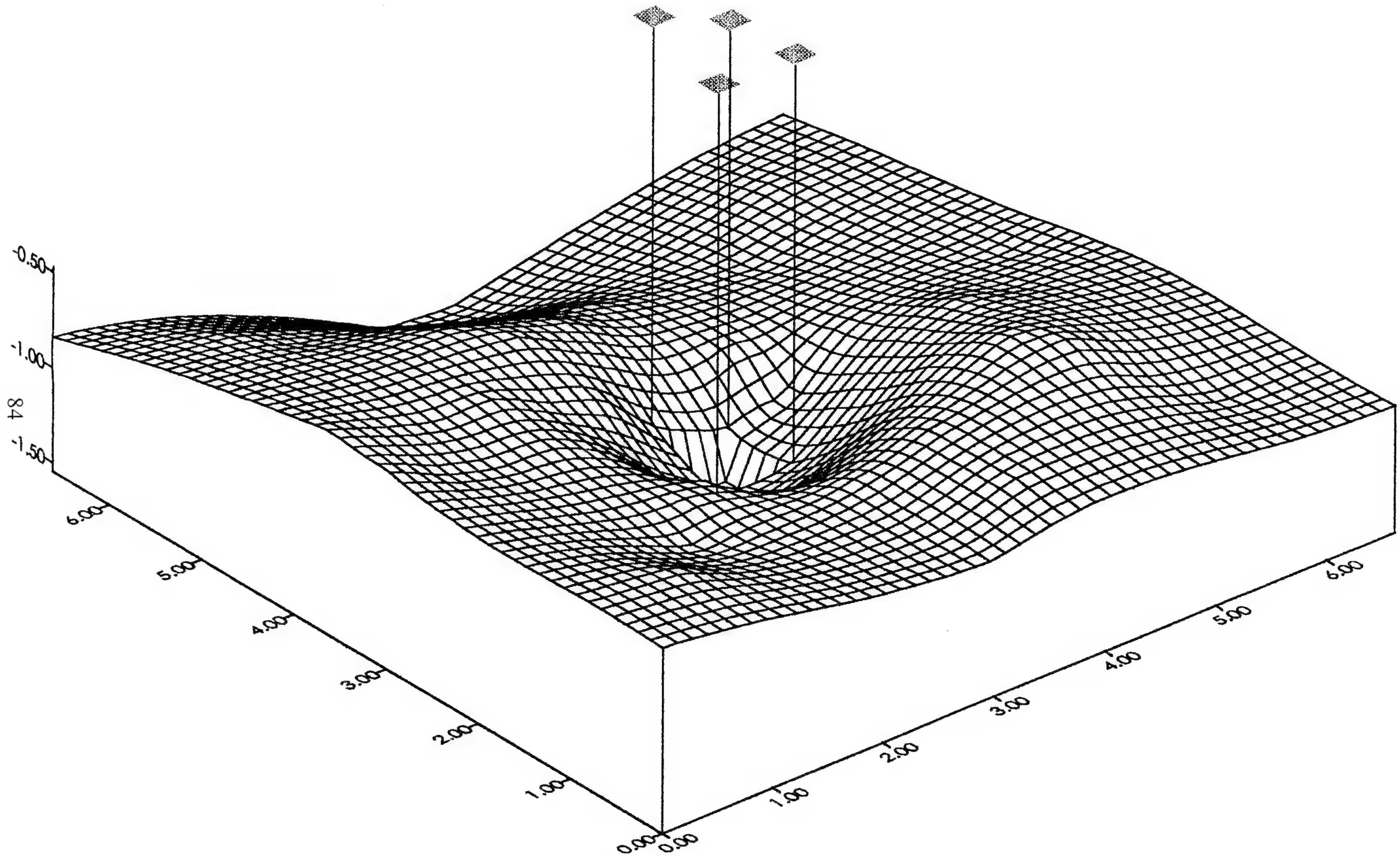
Number 11

22 August 1995

0930



Contour Plot #11



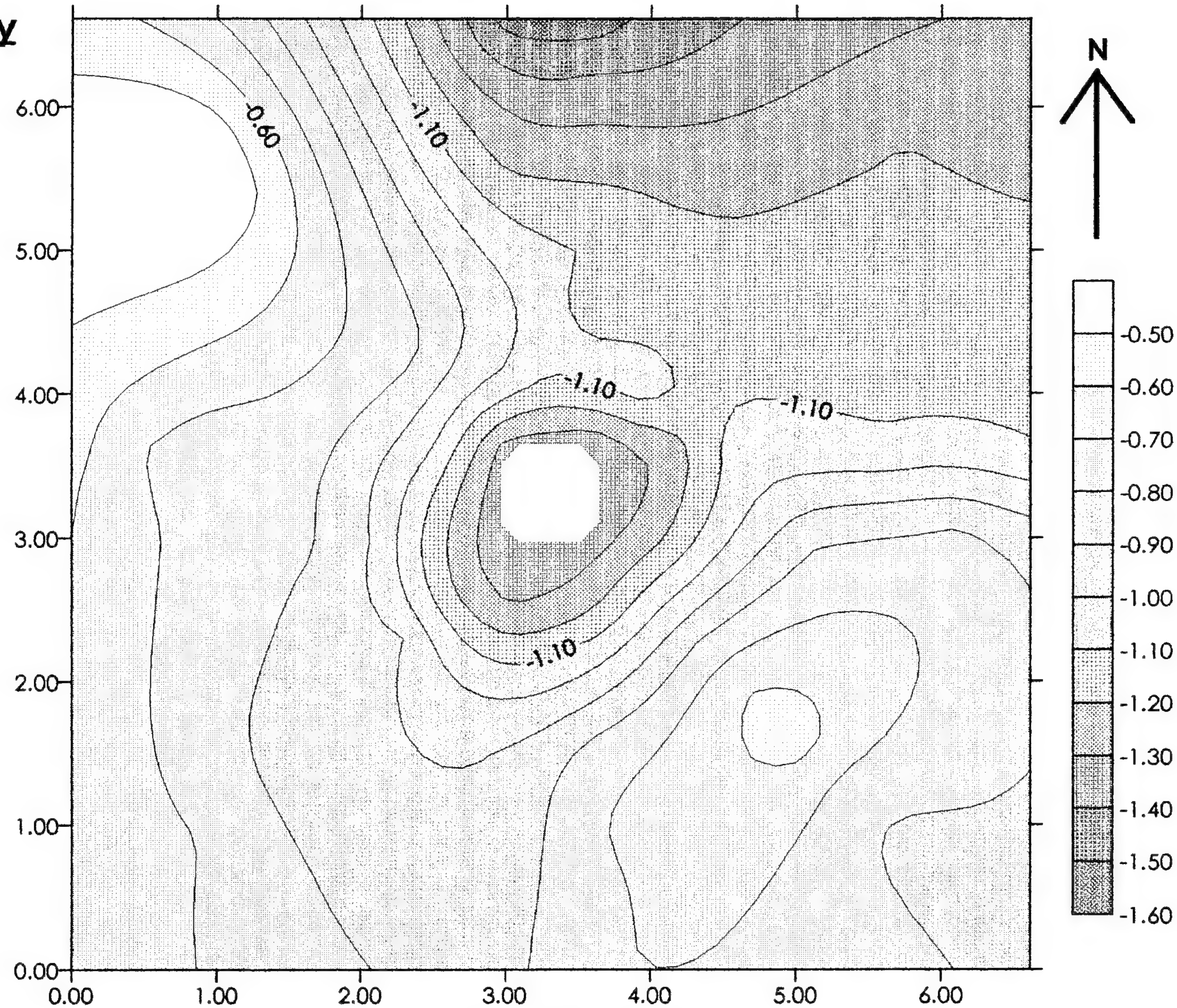
Surface Plot #11

Manual Survey

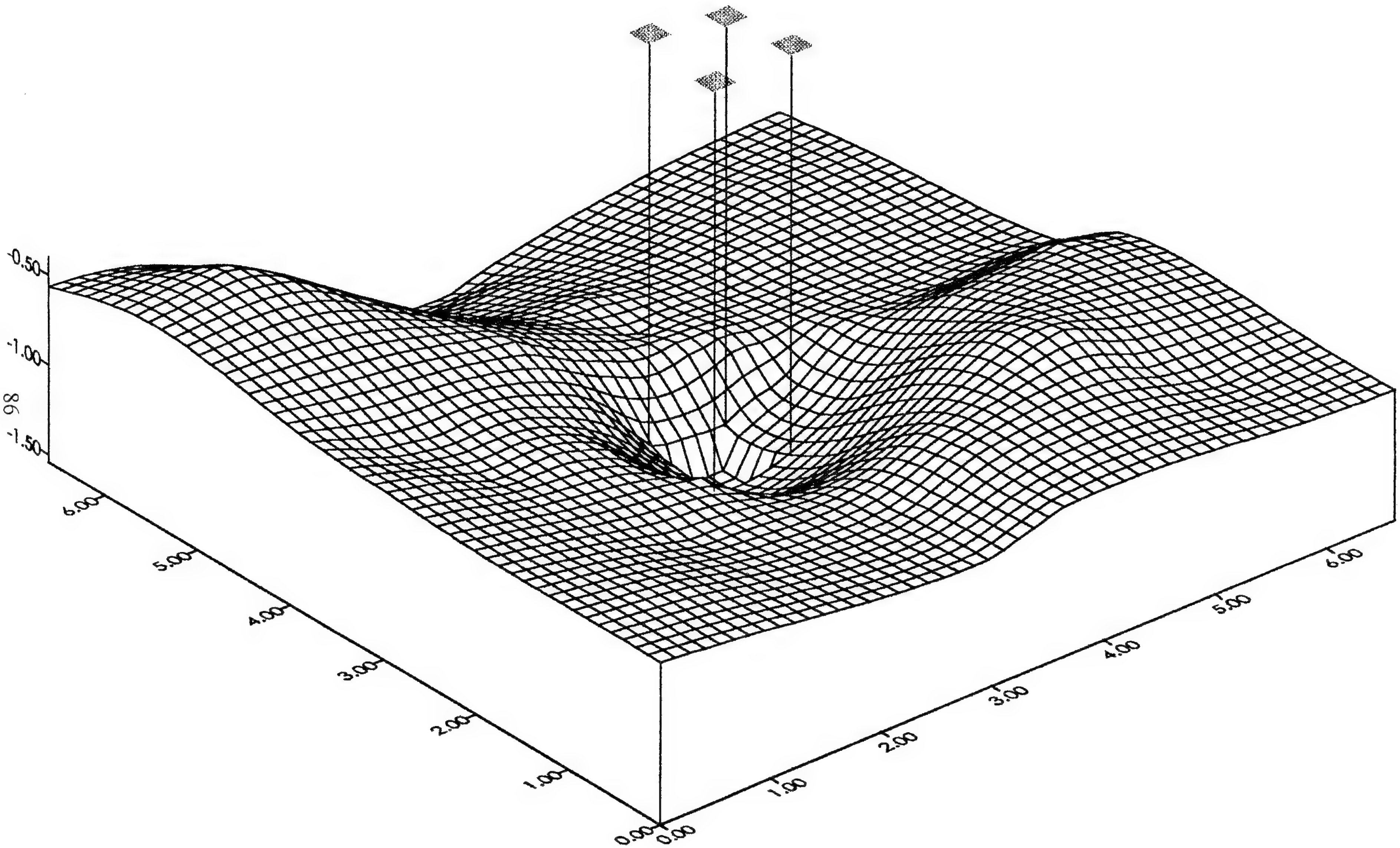
Number 12

22 August 1995

1600



Contour Plot #12



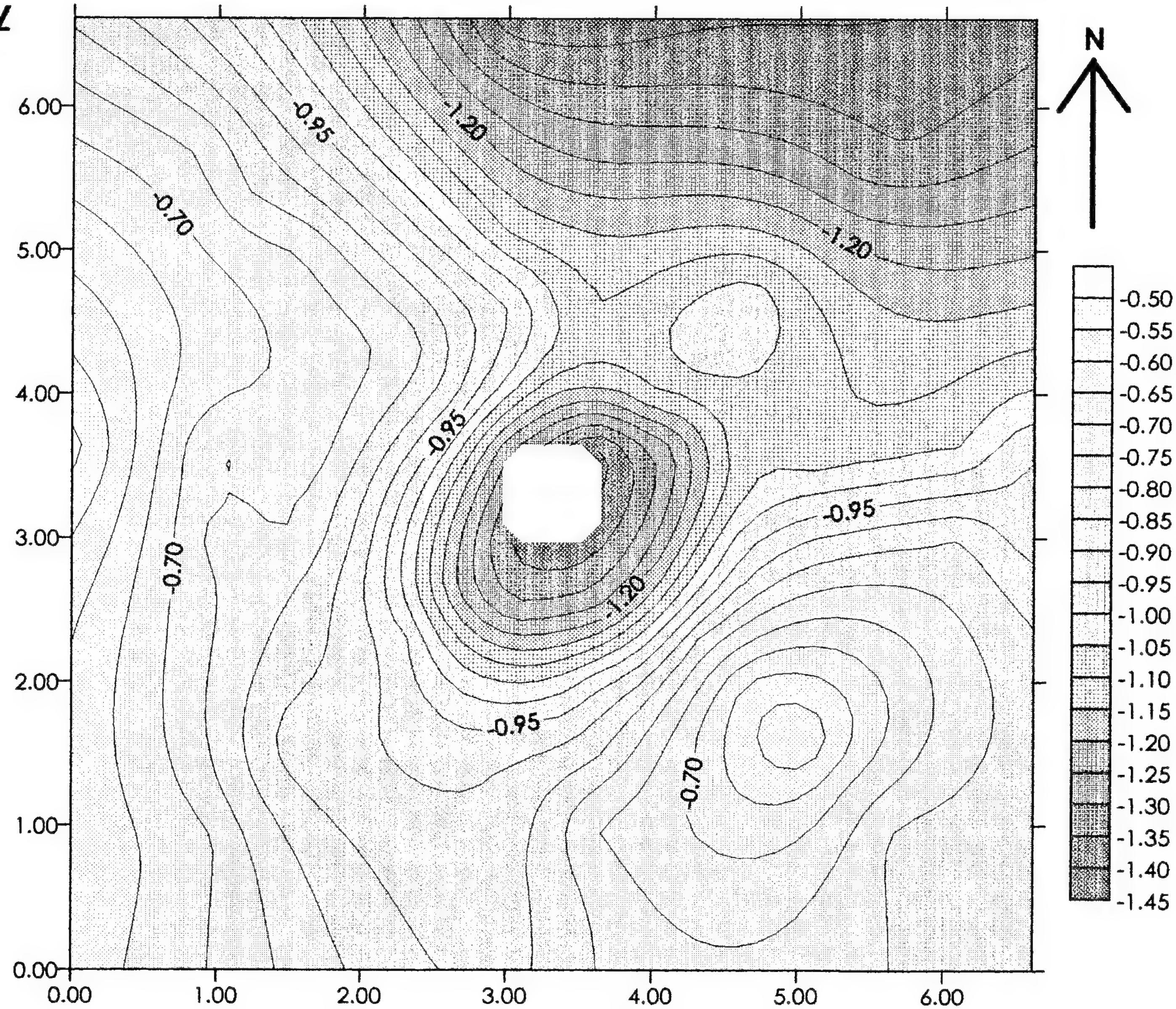
Surface Plot #12

Manual Survey

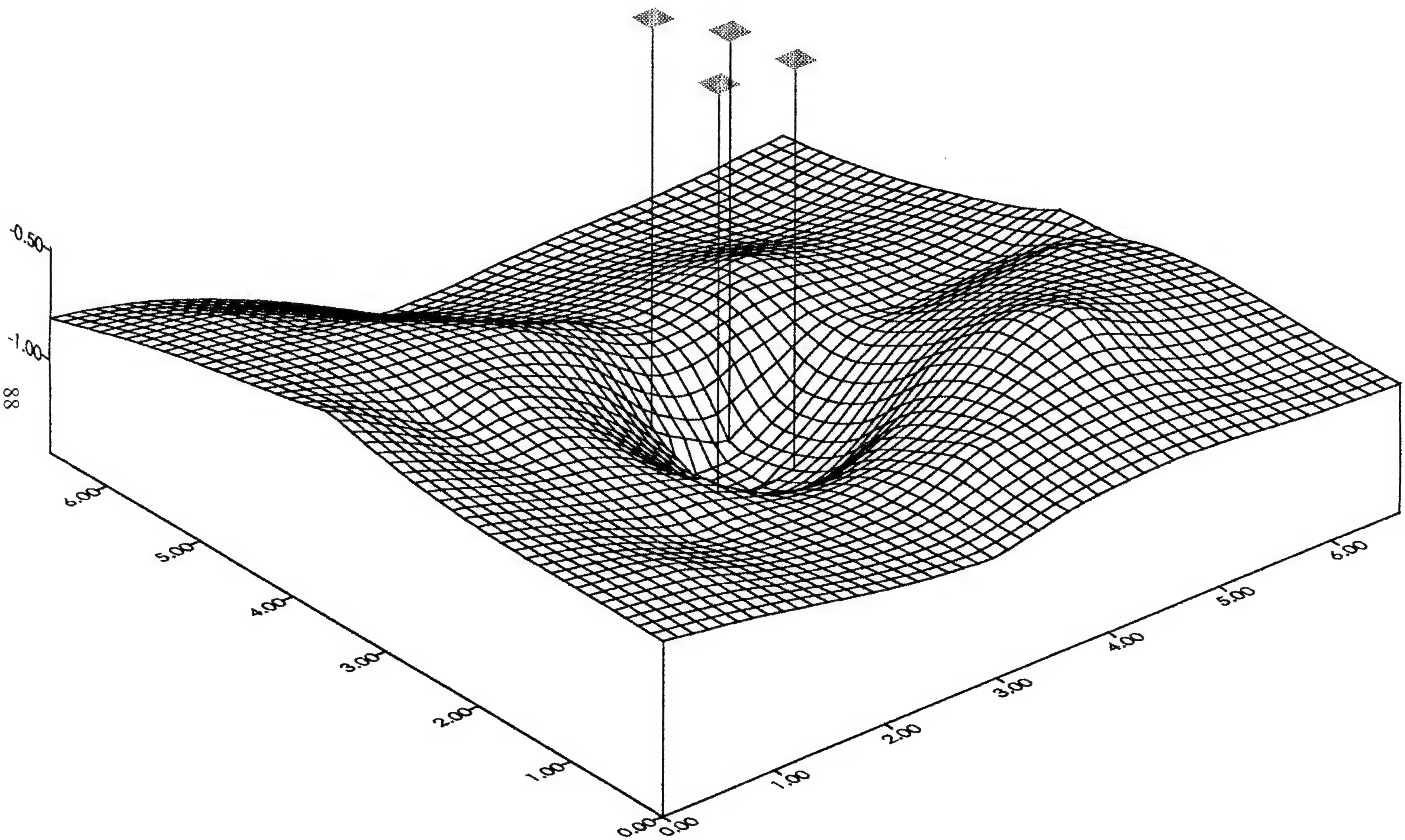
Number 13

23 August 1995

0900



Contour Plot #13



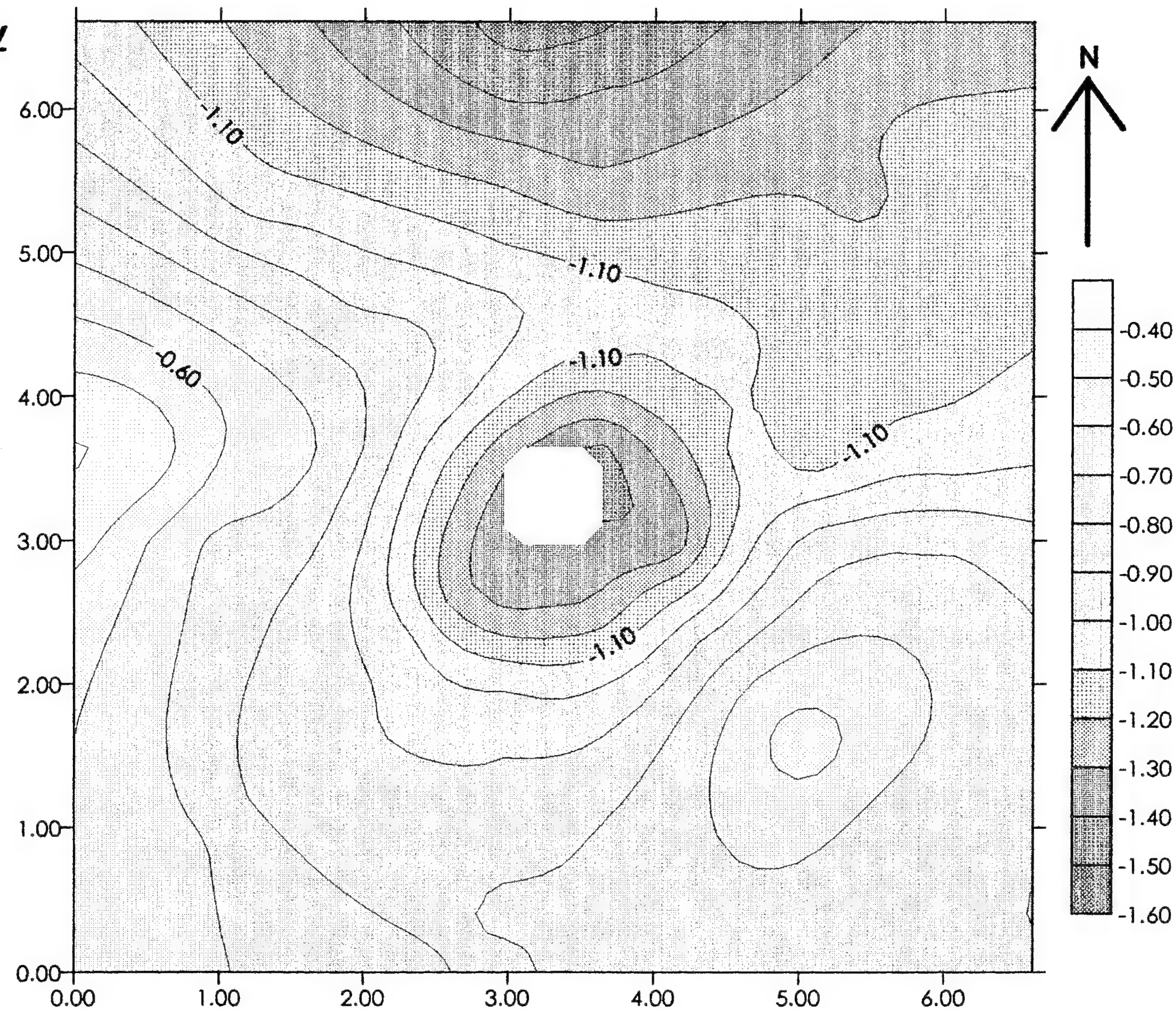
Surface Plot #13

Manual Survey

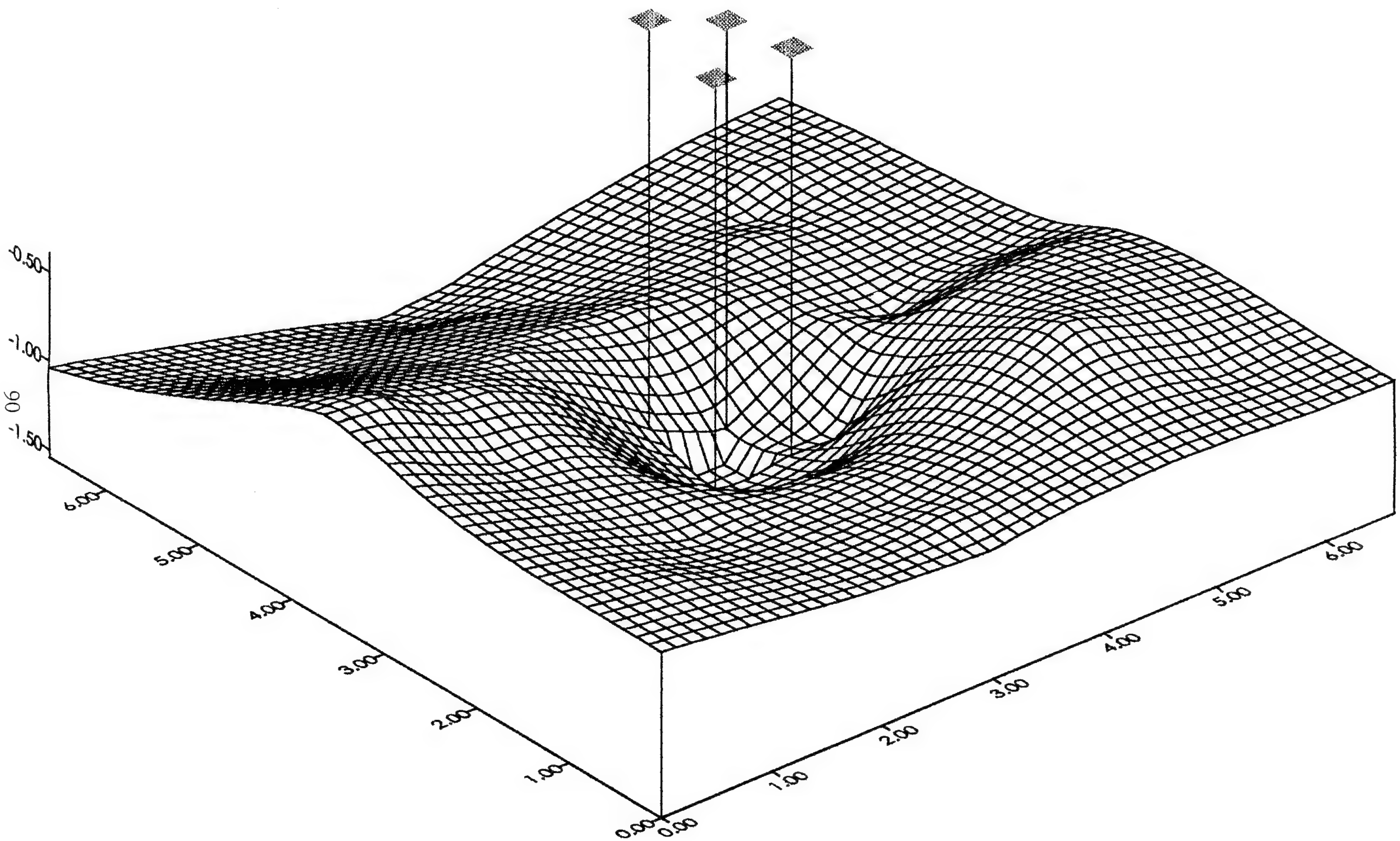
Number14

24 August 1995

0810



Contour Plot #14



Surface Plot #14

Appendix C

The following pages are the BASIC program that was written to control the Tatletale IV controller and datalogger. Full Credit for this program goes to Mr. Sidney Schofield, Coastal Engineering Laboratory.

```
' Written May 30 1990 by S.L. Schofield'
' '
' Program to control video recording and data acquistion for Wayne'
' Walker at Destin.'
' '
' Modification history '
' '
' DIO pin definitions'
' ************'
' VCR functions'
' dio pin (5) Pwr for VCR '
' dio pin (6) VCR record'
' dio pin (7) VCR play'
'************'
' '
' Other pin assignments'
' ************'
' dio pin (3)  current meter on/off'
' dio pin (8)  12V  for Camera '
' dio pin (9)  Lights on '
' dio pin (10) mezotech 24V supply '
' dio pin (11) 120VAC on (inverter) '
' '
'**************'
' '
' CLEAR ALL DIO LINES ON POWER UP'
   5 PCLR 0,1,2,3,4,5,6,7,8,9,10,11,12,13
  10 GOSUB 1590
' DEFAULT DATA ACQUISITION PARAMETERS ARE:
' EVERY 15 MINUTES D=900 SECONDS, AND FOR 20 SECONDS N=20'
  15 D=900:N=20
  20 ONERR 2500:SLEEP 0
' '
 100 GOTO 300
' Wait for terminal input or data taking'
 130 SLEEP 100
 131 RTIME:IF ?(0)%10=0 PRINT ?(2),':',#02,?(1),':',#02,?(0)
 135 IF @(98) + 10*N + 18<1015807 GOTO 210
 140 PRINT ' Data file is full you will need to dump the data'
 145 PRINT ' if you want to acquire more data.'
 150 GOTO 300
 210 IF (60 * ?(1) + ?(0))%D = 0 GOTO 1000
 270 GOTO 130
' TEMINAL HANDLING ROUTINES'
' Turn off watchdog timer.'
 300 SLEEP 0:SLEEP 50
' Clear out data buffer if anything there.'
 304 Q=0:W=0:GOSUB 6000
 305 W=0:ITEXT W,0:IF W<>0 GOTO 304
' Send prompt.'
 306 PRINT "DESTIN SCOUR > ";:V=?
' ALPHA TEXT INTO FIRST 20 LOCATIONS OF DATA BUFFER'
 310 W=0:ITEXT W,600
 315 IF W<>0 GOTO 330
 ' IF NO TERMINAL INPUT FOR 2 MINS. THEN BACK TO DATA MODE'
 320 IF ?-V>12000 GOTO 620
' WAIT FOR MORE '
 325 GOTO 310
' ALPHA TEXT RECEIVED SO GRAB IT AND MAKE ALL UPPERCASE'
 330 W=0:A=GET(W,#1):Z=GET(W,#1):IF A>91 A=A-32
```

```
 331 W=0:STORE W,#1,A:IF Z>91 Z=Z-32
 332 STORE W,#1,Z:@(80)=13:STORE W,#1,@(80):W=0:OTEXT W
' THEN CLEAR OUT BUFFER'
 335 W=0:ITEXT W,0:IF W<>0 GOTO 335
' COMMAND PARSER'
' '
' TIme TIME'
 340 IF A=84 & Z=73 GOTO 400
' POwer Inverter power on'
 345 IF A=80 & Z=79 PSET 11
' OFf Inverter power off '
 346 IF A=79 & Z=70 PCLR 11
' INit INITIALIZE DATA FILE POINTER'
 350 IF A=73 & Z=78 GOTO 500
' EXit EXIT MONITOR TO DATA WAIT LOOP'
 355 IF A=69 & Z=88 GOTO 600
' TEst SCAN CHANNELS FOR TESTING'
 360 IF A=84 & Z=69 GOTO 650
' DAta Dump Offload data file'
 365 IF A=68 & Z=65 GOTO 670
' STime SAMPLE TIME IN SECONDS'
 375 IF A=83 & Z=84 GOTO 900
' SAmple  Initiate a data sample burst'
 380 IF A=83 & Z=65 GOTO 995
' SInterval SAMPLE INTERVAL IN SECONDS'
 385 IF A=83 & Z=73 GOTO 3000
' QUit EXIT TO MONITOR  DEBUG USE ONLY'
 390 PRINT:IF A=81 & Z=85 GOTO 395
 392 GOTO 304
 395 INPUT "EXIT PROGRAM ARE YOU SURE [1/0] "E
 396 IF E<>1 GOTO 304
 397 PRINT "DROPPING INTO MONITOR TYPE *RUN TO CONTINUE":STOP
' display/set time/date'
 400 RTIME:PRINT ?(2),":",#02,?(1),":",#02,?(0)," ";
 405 PRINT ?(4),"-",?(3),"-",?(5)
 410 INPUT "YEAR "H:H=H%100:IF H=0 GOTO 304
 420 INPUT "MONTH "?(4):INPUT "DAY "?(3)
 430 INPUT "HOUR "?(2)
 435 INPUT "MINUTE "?(1)
 437 INPUT "SECONDS "?(0)
 440 ?(5)=H:STIME
 445 GOTO 304
 500 PRINT ' ARE YOU SURE YOU WANT TO INITIALIZE THE DATA POINTERS [1/0] ';
 501 INPUT""E:IF E=0 GOTO 304
' initialize data file pointer'
 550 GOSUB 1595
 570 PRINT'DATA FILE INITIALIZED ':PRINT:GOTO 304
' return to data wait mode'
 600 SLEEP 0:PRINT'RETURNING TO DATA MODE: '
 620 SLEEP 0:GOTO 130
' sample from A/D and output to terminal'
' q= number of samples , s=starting channel, r=ending channel'
 650 PSET 11:SLEEP 0:SLEEP 200:PSET 10,3
 651 INPUT " NUMBER OF SAMPLES "Q:INPUT" BEGINNING CHANNEL "S
' MUST TAKE AT LEAST 1 SAMPLE'
 652 IF Q<1 Q=1
' TURN ON ANALOG POWER.  LOWEST CHANNEL IS 0'
 653 IF S<0 S=0
' HIGHEST CHANNEL IS 7'
 654 IF S>7 S=7
```

```
' HIGHEST ENDING CHANNEL IS 7'
 655 INPUT" ENDING CHANNEL "R:IF R>7 R=7
' ENDING CHANNEL MUST BE >= STARTING CHANNEL'
 656 IF R<S R=S
' START THE TESTING'
 657 FOR E=1 TO Q
' OUTPUT THE RESULTS'
 658 FOR G=S TO R
 659 A=CHAN(G)+CHAN(G)+CHAN(G)+CHAN(G)+CHAN(G)
 660 A=(982*A)/(1024):PRINT A/1000,'.',#03,A%1000,' ';
 661 NEXT G
' DELAY A LITTLE AND RESAMPLE'
 664 A=A
 665 PRINT:SLEEP 0:SLEEP 75:NEXT E
 667 PCLR 10,3,4,11:GOTO 304
' store or offload the present data file'
 670 PRINT " TO OFFLOAD DATA FILE [1] "
 675 INPUT ""A:IF A<>1 GOTO 304
 695 OFFLD 500,X,5000,Z
 696 IF Z-1=X GOTO 304
 697 PRINT "OFFLOAD NOT COMPLETED ":GOTO 304
 900 PRINT "Input desired sample time in seconds:'
 905 PRINT "Default is 20 seconds:'
 910 INPUT "Sample Time",N
 920 IF N<=0 N=20
 950 GOTO 304
' Data taking mode for system'
 995 Q=1
1000 X=@(98)
1005 PRINT 'Entering data acquisition mode ',?(2),':',#02,?(1),':',#02,?(0)
1006 PRINT 'X POINTER IS ',X
1010 IF X+10*N +18 > 1015807 GOTO 140
1030 A=1:@(98)=X+10*N+18
1035 GOSUB 1600
' POWER UP SEQUENCE AND VCR START '
1036 GOSUB 4000
' START ACQUISITION OF ANALOG CHANNELS'
1040 SLEEP 0
1050 FOR E=N TO 1 STEP -1
1060 SLEEP 100:BURST X,5,2
1080 NEXT E
' POWER DOWN AND VCR SHUTDOWN'
1082 GOSUB 5000
1085 PRINT 'Exiting data mode ',?(2),':',#02,?(1),':',#02,?(0)
1090 PRINT 'X POINTER IS ',X
1200 IF Q=1 GOTO 304
1300 SLEEP 0:GOTO 130
' Turn on A/D convertor and power
1590 ASM &HBB,DB &HE:ASM &H9A,DW 16,0:RETURN
1595 X=500:STORE X,"DESTIN SCOUR DATA ":@(98)=X:RETURN
1600 RTIME
1620 STORE X,#2,43605:STORE X,#2,43605
1625 STORE X,#4,N*256+5:STORE X,#2,F:STORE X,#2,A
1630 FOR E=5 TO 0 STEP -1
1635 STORE X,#1,?(E):NEXT E
1660 RETURN
2500 IF X>1015807 GOTO 140
2510 GOTO 130
' '
3000 PRINT "Input desired sample interval in seconds:"
```

```
3005 PRINT "Default is 900 seconds [15 minutes]:"
3010 PRINT "Minimum is 300 seconds [every 5 minutes]:"
3015 PRINT "Maximum is 3600 seconds (once an hour):"
3020 INPUT "Sample Interval",D
3025 IF D<=0 D=900
3030 IF D<300 D=300
3035 IF D>3600 D=3600
3040 GOTO 304
' '
' Power up sequence:'
' 1.  pin 11 to 1 turns on 120 V power inverter. wait 5 seconds after.'
' 2.  pin 8 to 1 turns on camera.'
' 3.  pin 10 to 1 turns on mesotech.'
' 4.  pin 4 to 1 turns on current meter.'
' 5.  wait 20 seconds for all power to stabalize.'
' 6.  pin 9 to 1 turns on lights.'
'     Now power up VCR'
' 7.  pin 5 to 1 wait .5 sec. then pin 5 to 0. Power up VCR.'
' 8.  pin 6 to 1 wait .5 sec.  REC '
' 9.  pin 7 to 1 wait .5 sec.  PLAY '
'10.  pin 6 to 0 wait .5 sec. then pin 7 to 0 and return
'     from power up routine.'
' '
4000 PRINT " INVERTER TURNING ON":PSET 11:SLEEP 0:SLEEP 500
4005 PRINT " CAMERA ON":PSET 8
4010 PRINT " MESOTECH ON":PSET 10
4020 PRINT " CURRENT METER ON":PSET 3
4035 PRINT " 20 SECOND WARM UP PLEASE WAIT":SLEEP 0:SLEEP 2000
4040 PRINT " LIGHTS ON":PSET 9
4045 PRINT " VCR POWER UP":PSET 5:SLEEP 0:SLEEP 50:PCLR 5
4050 PRINT " PRESSING REC BUTTON":PSET 6:SLEEP 0:SLEEP 50
4055 PRINT " PRESSING PLAY BUTTON":PSET 7:SLEEP 0:SLEEP 50
4060 PRINT " RELEASING REC/PLAY BUTTON":PCLR 7:SLEEP 0:SLEEP 50:PCLR 6
4070 RETURN
' Power down sequence'
' Turn off lights then stop VCR then other devices.'
' 1.  pin 5 to 1 wait .5 sec. then pin 5 to 0. Power off VCR'
' 2.  pin 11 to 0. Turn iverter off'
' 3.  pins 4-12 to zero to turn off all auxillary power supplies'
5000 PRINT " LIGHTS OFF":PCLR 9
5005 PRINT " VCR POWER OFF":PSET 5:SLEEP 0:SLEEP 50:PCLR 5
5010 PRINT " 5 SECOND WAIT BEFORE FULL POWER DOWN":SLEEP 0:SLEEP 500
5015 PRINT " POWERING DOWN ALL OTHER VOLTAGES":PCLR 11
5020 PCLR 3,4,5,6,7,8,9,10,11,12
5025 RETURN
6000 PRINT " TIme   set time "
6005 PRINT " INit   initialize data pointer ",X
6010 PRINT " EXit   exit to data routines "
6015 PRINT " TEst   test analog channels "
6020 PRINT " DAta Dump  offload data file "
6030 PRINT " STime  set total data run time ",N
6035 PRINT " SInterval set data taking interval ",D
6040 PRINT " SAmple start a data burst immediately "
6045 PRINT " PO Inverter power on "
6046 PRINT " OFf Inverter power off "
6050 RETURN
```

Appendix D

The following pages are the calibrated Tattletale data.

Appendix D Calibrated Tattletale Data

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/15/95	20:00:00	0.00	-0.88	-6.61	6.67	262.46	109.5
8/15/95	20:15:00	15.00	-0.27	-5.49	5.49	267.24	104.6
8/15/95	20:30:00	30.00	1.05	-7.46	7.53	278.05	104.1
8/15/95	20:45:00	45.00	2.90	-6.29	6.93	294.80	104.1
8/15/95	21:00:00	60.00	5.23	-7.94	9.51	303.41	106.7
8/15/95	21:15:00	75.00	6.24	-7.94	10.10	308.19	104.6
8/15/95	21:30:01	90.00	3.26	-8.82	9.40	290.32	104.3
8/15/95	21:45:00	105.00	5.23	-8.26	9.78	302.37	104.8
8/15/95	22:00:00	120.00	6.96	-10.07	12.24	304.68	104.5
8/15/95	22:15:00	135.00	8.04	-10.63	13.33	307.12	104.4
8/15/95	22:30:00	150.00	9.41	-13.36	16.34	305.18	104.2
8/15/95	22:45:00	165.00	13.95	-11.07	17.81	321.58	104.4
8/15/95	23:00:00	180.00	16.44	-15.29	22.45	317.09	104.9
8/15/95	23:15:00	195.00	24.56	-9.91	26.49	338.03	104.4
8/15/95	23:30:00	210.00	24.64	-15.37	29.04	328.05	104.2
8/15/95	23:45:00	225.00	21.39	-20.56	29.67	316.14	103.9
8/16/95	0:00:00	240.00	24.48	-19.15	31.08	321.97	104.0
8/16/95	0:15:00	255.00	22.59	-17.30	28.46	322.56	104.0
8/16/95	0:30:00	270.00	24.04	-11.55	26.67	334.35	105.4
8/16/95	0:45:01	285.00	22.55	-11.39	25.27	333.21	103.8
8/16/95	1:00:00	300.00	25.12	-12.00	27.84	334.47	103.9
8/16/95	1:15:00	315.00	16.97	-9.38	19.39	331.08	104.6
8/16/95	1:30:00	330.00	-4.81	-0.78	4.87	189.19	104.0
8/16/95	1:45:00	345.00	-17.31	7.45	18.84	156.70	105.1
8/16/95	2:00:00	360.00	-19.32	6.77	20.47	160.68	104.2
8/16/95	2:15:00	375.00	4.27	-6.01	7.37	305.43	104.3
8/16/95	2:30:00	390.00	25.12	-26.26	36.34	313.74	103.7
8/16/95	2:45:00	405.00	53.78	-36.39	64.94	325.92	104.2
8/16/95	3:00:00	420.00	57.84	-28.03	64.28	334.15	103.8
8/16/95	3:15:00	435.00	42.00	-18.15	45.76	336.63	102.9
8/16/95	3:30:00	450.00	30.99	-11.43	33.03	339.76	104.2
8/16/95	3:45:00	465.00	19.58	-11.07	22.50	330.53	104.1
8/16/95	4:00:00	480.00	7.92	-5.77	9.80	323.95	104.3
8/16/95	4:15:00	495.00	-2.00	-3.20	3.77	238.04	103.7
8/16/95	4:30:00	510.00	-9.20	1.10	9.26	173.16	103.5
8/16/95	4:45:00	525.00	-16.55	4.48	17.14	164.84	101.4
8/16/95	5:00:00	540.00	-10.56	-5.12	11.73	205.87	103.5
8/16/95	5:15:00	555.00	1.53	-5.97	6.16	284.42	103.5
8/16/95	5:30:00	570.00	3.02	-6.73	7.38	294.21	103.4
8/16/95	5:45:00	585.00	-1.84	-2.43	3.04	232.92	103.6
8/16/95	6:00:00	600.00	-0.47	-6.01	6.03	265.57	104.0
8/16/95	6:15:00	615.00	7.44	-12.52	14.56	300.74	103.6
8/16/95	6:30:00	630.00	15.00	-13.64	20.28	317.73	103.5
8/16/95	6:45:00	645.00	19.90	-14.69	24.74	323.58	102.3
8/16/95	7:00:00	660.00	3.26	-9.10	9.67	289.74	104.4
8/16/95	7:15:00	675.00	-13.25	2.63	13.50	168.76	104.0
8/16/95	7:30:00	690.00	-16.15	1.55	16.22	174.51	103.8

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/16/95	7:45:00	705.00	-14.22	3.27	14.59	167.04	104.5
8/16/95	8:00:00	720.00	-18.08	1.79	18.16	174.34	104.3
8/16/95	8:15:00	735.00	-26.72	5.52	27.28	168.32	104.7
8/16/95	8:30:00	750.00	-20.57	10.83	23.24	152.22	104.5
8/16/95	8:45:00	765.00	-20.53	11.43	23.49	150.88	104.5
8/16/95	9:00:00	780.00	-19.80	8.18	21.42	157.54	105.1
8/16/95	9:15:00	795.00	-12.25	13.88	18.51	131.41	104.6
8/16/95	9:30:00	810.00	-12.53	5.73	13.77	155.41	104.6
8/16/95	9:45:00	825.00	-24.35	10.67	26.58	156.33	104.8
8/16/95	10:00:00	840.00	-17.71	10.79	20.74	148.64	105.0
8/16/95	11:30:00	940.00	-27.96	14.08	31.30	153.26	106.4
8/16/95	11:45:01	955.00	-19.84	1.87	19.92	174.61	106.3
8/16/95	12:00:00	970.00	-18.28	7.29	19.68	158.25	110.2
8/16/95	12:15:47	985.00	-27.52	13.36	30.59	154.10	106.9
8/16/95	12:30:00	1000.00	-24.43	11.79	27.12	154.23	107.5
8/16/95	12:45:00	1015.00	-26.23	7.98	27.41	163.07	107.0
8/16/95	13:00:00	1030.00	-28.81	13.96	32.01	154.14	106.9
8/16/95	13:15:00	1045.00	-22.26	8.10	23.68	160.00	107.5
8/16/95	13:30:00	1060.00	-20.13	6.37	21.11	162.43	106.8
8/16/95	13:45:00	1075.00	-19.92	4.08	20.33	168.42	106.8
8/16/95	14:00:00	1090.00	-17.63	2.39	17.79	172.27	107.7
8/16/95	14:15:00	1105.00	-15.99	3.64	16.39	167.16	106.7
8/16/95	14:30:00	1120.00	-14.42	4.76	15.18	161.72	28.8
8/16/95	14:45:00	1135.00	-20.69	6.89	21.80	161.57	98.9
8/16/95	15:00:00	1150.00	-18.48	6.65	19.64	160.20	98.3
8/16/95	15:15:00	1165.00	-18.84	7.49	20.27	158.31	87.6
8/16/95	15:30:00	1180.00	-15.58	7.57	17.32	154.07	86.7
8/16/95	15:45:00	1195.00	-17.03	5.48	17.89	162.15	83.8
8/16/95	16:00:00	1210.00	-15.54	3.07	15.84	168.81	83.9
8/16/95	16:15:00	1225.00	-15.71	1.87	15.82	173.20	94.4
8/16/95	16:30:00	1240.00	-13.17	1.99	13.31	171.39	94.6
8/16/95	16:45:01	1255.00	-12.57	2.15	12.75	170.28	94.4
8/16/95	17:00:00	1270.00	-9.88	0.22	9.88	178.71	94.4
8/16/95	17:15:00	1285.00	-6.99	-0.78	7.03	186.35	94.4
8/16/95	17:30:00	1300.00	66.35	58.37	88.38	41.34	111.5
8/16/95	17:45:00	1315.00	14.92	14.37	20.72	43.92	33.9
8/16/95	18:00:00	1330.00	-9.44	4.52	10.46	154.39	54.3
8/16/95	18:15:00	1345.00	-10.84	9.38	14.33	139.11	15.5
8/16/95	18:30:00	1360.00	-12.73	5.20	13.75	157.76	46.9
8/16/95	18:45:00	1375.00	-8.79	2.19	9.05	165.99	44.2
8/16/95	19:00:00	1390.00	-9.56	2.27	9.82	166.62	35.9
8/16/95	19:15:00	1405.00	61.13	60.30	85.87	44.61	111.5
8/16/95	19:30:00	1420.00	0.77	-1.15	1.38	304.03	37.6
8/16/95	19:45:00	1435.00	7.48	-5.41	9.23	324.15	37.4
8/16/95	20:00:00	1450.00	7.52	-6.33	9.83	319.94	37.5
8/16/95	20:15:00	1465.00	9.33	-5.41	10.79	329.92	37.1
8/16/95	20:30:00	1480.00	11.90	-9.95	15.51	320.12	37.0
8/16/95	20:45:00	1495.00	-1.44	0.26	1.46	169.64	37.2
8/16/95	21:00:00	1510.00	-7.75	1.02	7.81	172.48	37.1
8/16/95	21:15:00	1525.00	-11.93	6.93	13.79	149.83	36.9

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/16/95	21:30:00	1540.00	-10.00	3.19	10.49	162.29	36.5
8/16/95	21:45:00	1555.00	-4.69	1.30	4.86	164.47	33.1
8/16/95	22:00:00	1570.00	-5.18	3.56	6.28	145.46	33.1
8/16/95	22:15:01	1585.00	-2.24	0.18	2.24	175.34	33.2
8/16/95	22:30:00	1600.00	4.63	-2.79	5.41	328.97	33.1
8/16/95	22:45:00	1615.00	9.09	-4.88	10.32	331.79	33.2
8/16/95	23:00:00	1630.00	14.07	-8.14	16.26	329.96	33.2
8/16/95	23:15:00	1645.00	21.79	-12.72	25.23	329.74	33.2
8/16/95	23:30:00	1660.00	22.95	-4.52	23.40	348.87	33.7
8/16/95	23:45:00	1675.00	22.07	-9.75	24.13	336.17	33.7
8/17/95	0:00:00	1690.00	31.47	-14.73	34.75	334.92	33.8
8/17/95	0:15:00	1705.00	30.63	-20.60	36.92	326.08	33.8
8/17/95	0:30:00	1720.00	24.96	-13.56	28.41	331.49	34.2
8/17/95	0:40:00	1730.00	24.96	-18.06	30.81	324.12	34.7
8/17/95	0:50:00	1740.00	30.15	-19.15	35.72	327.59	34.5
8/17/95	1:00:00	1750.00	24.60	-8.02	25.88	341.95	34.5
8/17/95	1:10:00	1760.00	31.51	-17.70	36.14	330.68	34.7
8/17/95	1:20:00	1770.00	28.94	-8.42	30.14	343.78	34.6
8/17/95	1:30:00	1780.00	36.62	-11.51	38.39	342.56	34.6
8/17/95	1:40:00	1790.00	35.93	-14.29	38.67	338.32	35.5
8/17/95	1:50:01	1800.00	36.58	-13.16	38.88	340.22	35.5
8/17/95	2:00:00	1810.00	33.84	-11.88	35.87	340.66	35.1
8/17/95	2:10:00	1820.00	30.87	-11.27	32.87	339.95	35.1
8/17/95	2:20:00	1830.00	32.96	-11.92	35.05	340.12	35.3
8/17/95	2:30:00	1840.00	41.64	-15.09	44.29	340.08	34.8
8/17/95	2:40:00	1850.00	39.03	-15.41	41.97	338.46	36.0
8/17/95	2:50:00	1860.00	35.89	-14.09	38.56	338.57	36.2
8/17/95	3:00:00	1870.00	39.47	-18.71	43.68	334.64	36.3
8/17/95	3:10:00	1880.00	35.77	-12.88	38.02	340.20	36.6
8/17/95	3:20:00	1890.00	30.91	-11.59	33.02	339.45	36.8
8/17/95	3:30:00	1900.00	39.87	-16.34	43.09	337.72	37.6
8/17/95	3:40:00	1910.00	35.69	-15.33	38.85	336.76	37.4
8/17/95	3:50:00	1920.00	29.46	-12.44	31.98	337.11	37.4
8/17/95	4:00:01	1930.00	31.92	-11.15	33.82	340.75	36.8
8/17/95	4:10:00	1940.00	32.60	-12.00	34.74	339.80	37.8
8/17/95	4:20:00	1950.00	29.38	-11.68	31.62	338.33	36.9
8/17/95	4:30:00	1960.00	32.96	-11.15	34.80	341.32	36.8
8/17/95	4:40:00	1970.00	29.18	-10.87	31.14	339.58	37.4
8/17/95	4:50:00	1980.00	25.65	-11.19	27.99	336.44	37.5
8/17/95	5:00:00	1990.00	24.04	-10.63	26.29	336.15	37.7
8/17/95	5:10:00	2000.00	30.27	-13.36	33.09	336.19	37.4
8/17/95	5:20:00	2010.00	24.92	-9.14	26.55	339.87	37.5
8/17/95	5:30:00	2020.00	25.24	-12.36	28.11	333.92	38.3
8/17/95	5:40:00	2030.00	25.85	-9.95	27.70	338.96	38.0
8/17/95	5:50:00	2040.00	25.65	-10.75	27.82	337.27	37.9
8/17/95	6:00:00	2050.00	24.44	-8.30	25.81	341.25	37.9
8/17/95	6:10:01	2060.00	17.53	-6.49	18.70	339.70	38.0
8/17/95	6:20:00	2070.00	18.49	-9.14	20.63	333.71	38.1
8/17/95	6:30:00	2080.00	14.84	-5.69	15.90	339.04	37.9
8/17/95	6:40:00	2090.00	10.90	-5.29	12.12	334.13	37.9

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/17/95	6:50:00	2100.00	12.14	-5.12	13.18	337.15	38.0
8/17/95	7:00:00	2110.00	7.48	-3.88	8.43	332.61	38.7
8/17/95	7:10:00	2120.00	5.83	-1.67	6.07	344.05	37.9
8/17/95	7:20:00	2130.00	2.70	-3.04	4.07	311.68	37.9
8/17/95	7:30:00	2140.00	0.57	-1.07	1.21	298.30	37.9
8/17/95	7:40:00	2150.00	-0.07	-2.07	2.07	268.20	37.9
8/17/95	7:50:00	2160.00	-1.36	-1.39	1.94	225.68	37.9
8/17/95	8:00:00	2170.00	-5.82	-1.51	6.01	194.54	37.9
8/17/95	8:10:00	2180.00	-9.68	0.78	9.71	175.38	37.9
8/17/95	8:20:01	2190.00	-10.08	7.41	12.51	143.66	38.0
8/17/95	8:30:00	2200.00	-13.54	4.88	14.39	160.16	38.0
8/17/95	8:40:00	2210.00	-12.33	5.36	13.44	156.49	38.0
8/17/95	8:50:00	2220.00	-13.05	6.33	14.50	154.11	37.9
8/17/95	9:00:00	2230.00	-16.19	7.33	17.77	155.63	38.1
8/17/95	9:10:00	2240.00	-14.62	7.53	16.44	152.73	37.9
8/17/95	9:20:00	2250.00	-15.38	6.73	16.78	156.35	38.2
8/17/95	9:30:00	2260.00	-14.14	5.32	15.10	159.37	37.9
8/17/95	9:40:00	2270.00	-13.98	5.52	15.03	158.44	37.0
8/17/95	9:50:00	2280.00	-10.56	11.03	15.27	133.73	37.4
8/17/95	10:00:00	2290.00	-7.43	10.23	12.64	125.97	37.2
8/17/95	10:10:00	2300.00	-20.09	15.25	25.22	142.79	37.0
8/17/95	10:20:00	2310.00	-26.15	11.07	28.39	157.05	37.4
8/17/95	10:30:01	2320.00	-29.45	21.36	36.38	144.04	31.0
8/17/95	10:40:00	2330.00	-28.52	18.71	34.11	146.73	35.5
8/17/95	10:50:00	2340.00	-26.27	18.22	31.97	145.25	34.8
8/17/95	11:00:00	2350.00	-27.04	17.70	32.32	146.78	33.0
8/17/95	11:10:00	2360.00	-28.12	20.63	34.87	143.73	32.4
8/17/95	11:20:00	2370.00	-34.47	25.94	43.14	143.03	27.7
8/17/95	11:30:00	2380.00	-39.70	28.03	48.60	144.77	33.1
8/17/95	11:40:00	2390.00	-34.15	17.90	38.55	152.33	31.2
8/17/95	11:50:00	2400.00	-32.46	20.31	38.29	147.96	31.1
8/17/95	12:00:00	2410.00	-31.82	21.48	38.39	145.97	32.7
8/17/95	12:10:00	2420.00	-34.07	18.54	38.78	151.44	33.6
8/17/95	12:20:00	2430.00	-33.47	16.62	37.37	153.59	34.8
8/17/95	12:30:00	2440.00	-33.59	21.12	39.67	147.83	35.4
8/17/95	12:40:00	2450.00	-31.90	15.25	35.35	154.44	36.0
8/17/95	12:50:00	2460.00	-30.25	17.18	34.78	150.40	36.6
8/17/95	13:00:00	2470.00	-33.59	18.58	38.38	151.04	36.8
8/17/95	13:10:00	2480.00	-31.22	18.26	36.16	149.67	37.7
8/17/95	13:20:00	2490.00	-28.85	21.08	35.73	143.84	37.9
8/17/95	13:30:00	2500.00	-28.28	17.38	33.19	148.42	38.5
8/17/95	13:40:00	2510.00	-28.36	18.42	33.81	146.99	39.1
8/17/95	13:50:00	2520.00	-29.73	17.06	34.27	150.14	39.4
8/17/95	14:00:00	2530.00	-27.16	15.53	31.28	150.23	39.6
8/17/95	14:10:01	2540.00	-23.78	16.41	28.89	145.38	39.9
8/17/95	14:20:00	2550.00	-26.92	18.58	32.71	145.38	40.4
8/17/95	14:30:00	2560.00	-27.56	19.43	33.72	144.81	40.7
8/17/95	14:40:00	2570.00	-30.33	17.62	35.07	149.84	41.3
8/17/95	14:50:00	2580.00	-30.69	19.11	36.15	148.08	41.3
8/17/95	15:00:00	2590.00	-27.32	19.43	33.52	144.57	41.7

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/17/95	15:10:00	2600.00	-27.88	17.06	32.68	148.53	42.4
8/17/95	15:20:00	2610.00	-25.43	13.24	28.67	152.49	42.1
8/17/95	15:30:00	2620.00	-30.82	17.58	35.48	150.29	42.8
8/17/95	15:40:00	2630.00	-25.63	17.02	30.76	146.40	42.3
8/17/95	15:50:00	2640.00	-22.01	11.27	24.72	152.88	42.1
8/17/95	16:00:00	2650.00	-26.84	17.34	31.95	147.13	42.5
8/17/95	16:10:00	2660.00	-27.36	16.70	32.05	148.59	43.2
8/17/95	16:20:01	2670.00	-28.52	17.38	33.40	148.63	43.2
8/17/95	16:30:00	2680.00	-25.71	15.05	29.79	149.65	42.9
8/17/95	16:36:15	2690.00	-29.05	15.97	33.15	151.19	43.3
8/17/95	16:40:00	2700.00	-30.45	19.87	36.36	146.87	43.4
8/17/95	16:48:39	2710.00	-26.15	12.48	28.97	154.48	43.1
8/17/95	17:00:00	2720.00	-23.46	16.45	28.65	144.95	43.4
8/17/95	17:03:44	2730.00	-24.83	14.45	28.73	149.79	44.0
8/17/95	17:11:31	2740.00	-22.90	17.26	28.67	142.98	43.8
8/17/95	17:20:00	2750.00	-25.43	14.45	29.25	150.38	44.3
8/17/95	17:30:00	2760.00	-21.81	12.40	25.09	150.37	44.2
8/17/95	17:40:00	2770.00	-24.55	17.26	30.01	144.88	44.7
8/17/95	17:50:00	2780.00	-24.67	15.13	28.94	148.47	44.5
8/17/95	18:00:00	2790.00	-22.30	10.67	24.72	154.42	44.2
8/17/95	18:10:01	2800.00	-18.68	9.42	20.92	153.23	44.4
8/17/95	18:20:00	2810.00	-20.61	10.59	23.17	152.79	44.5
8/17/95	18:30:00	2820.00	-20.17	9.14	22.14	155.61	44.9
8/17/95	18:40:00	2830.00	-16.87	9.30	19.26	151.12	45.1
8/17/95	18:50:00	2840.00	-19.40	11.79	22.70	148.70	44.8
8/17/95	19:00:00	2850.00	-18.00	9.66	20.42	151.77	45.0
8/17/95	19:10:00	2860.00	-12.97	7.49	14.97	149.98	44.6
8/17/95	19:20:00	2870.00	-12.49	8.18	14.93	146.76	44.6
8/17/95	19:30:00	2880.00	-10.88	5.56	12.21	152.91	44.9
8/17/95	19:40:01	2890.00	-11.53	5.89	12.94	152.92	44.9
8/17/95	19:50:00	2900.00	-6.94	2.83	7.49	157.78	44.6
8/17/95	20:00:00	2910.00	-8.99	2.79	9.41	162.74	44.9
8/17/95	20:10:00	2920.00	-6.58	2.95	7.21	155.82	44.8
8/17/95	20:20:00	2930.00	-5.86	4.44	7.35	142.81	44.8
8/17/95	20:30:00	2940.00	-6.82	1.99	7.10	163.70	44.7
8/17/95	20:40:00	2950.00	-4.69	1.99	5.09	156.96	44.5
8/17/95	20:50:00	2960.00	-2.73	1.10	2.94	157.98	44.7
8/17/95	21:00:00	2970.00	-0.27	0.22	0.35	140.02	44.6
8/17/95	21:10:01	2980.00	4.27	-3.56	5.56	320.23	44.7
8/17/95	21:20:00	2990.00	4.31	-3.24	5.39	323.12	44.7
8/17/95	21:30:00	3000.00	5.91	-4.08	7.18	325.42	44.8
8/17/95	21:40:00	3010.00	7.60	-4.84	9.01	327.54	44.7
8/17/95	21:50:00	3020.00	9.85	-6.37	11.73	327.13	44.7
8/17/95	22:00:00	3030.00	13.23	-7.25	15.09	331.29	45.1
8/17/95	22:10:00	3040.00	15.04	-8.30	17.18	331.12	44.8
8/17/95	22:20:00	3050.00	20.34	-9.95	22.65	333.94	44.6
8/17/95	22:30:00	3060.00	17.57	-8.02	19.32	335.48	44.3
8/17/95	22:40:01	3070.00	19.70	-9.51	21.88	334.24	44.7
8/17/95	22:50:00	3080.00	22.27	-10.07	24.44	335.68	44.5
8/17/95	23:00:00	3090.00	27.53	-9.18	29.02	341.57	44.1

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/17/95	23:10:00	3100.00	22.55	-6.93	23.59	342.93	43.6
8/17/95	23:20:00	3110.00	24.08	-8.90	25.68	339.72	43.3
8/17/95	23:30:00	3120.00	30.99	-20.11	36.95	327.03	43.8
8/17/95	23:40:00	3130.00	34.49	-25.66	42.99	323.36	43.8
8/17/95	23:50:00	3140.00	29.62	-19.51	35.47	326.64	44.4
8/18/95	0:00:00	3150.00	19.70	-15.21	24.89	322.34	44.0
8/18/95	0:10:01	3160.00	21.79	-12.36	25.05	330.45	44.0
8/18/95	0:20:00	3170.00	25.97	-16.30	30.66	327.89	43.8
8/18/95	0:30:00	3180.00	23.48	-12.16	26.45	332.63	44.2
8/18/95	0:40:00	3190.00	23.64	-15.45	28.24	326.84	44.1
8/18/95	0:50:00	3200.00	28.26	-11.64	30.57	337.62	43.4
8/18/95	1:00:00	3210.00	31.92	-7.86	32.88	346.17	43.3
8/18/95	1:10:00	3220.00	31.31	-8.30	32.40	345.16	43.6
8/18/95	1:20:00	3230.00	35.01	-7.74	35.86	347.54	44.8
8/18/95	1:30:00	3240.00	33.64	-10.35	35.20	342.90	44.9
8/18/95	1:40:00	3250.00	32.56	-8.38	33.63	345.57	45.4
8/18/95	1:50:00	3260.00	33.40	-9.14	34.63	344.70	45.9
8/18/95	2:00:00	3270.00	31.03	-8.74	32.24	344.28	46.2
8/18/95	2:10:00	3280.00	33.68	-9.14	34.90	344.82	46.5
8/18/95	2:20:00	3290.00	37.98	-11.76	39.76	342.80	47.1
8/18/95	2:30:00	3300.00	29.42	-11.31	31.52	338.98	46.9
8/18/95	2:40:00	3310.00	30.71	-12.84	33.29	337.32	47.1
8/18/95	2:50:00	3320.00	37.82	-16.02	41.08	337.05	47.0
8/18/95	3:00:00	3330.00	34.85	-15.05	37.96	336.65	46.6
8/18/95	3:10:00	3340.00	34.73	-13.28	37.19	339.08	47.1
8/18/95	3:20:00	3350.00	29.46	-10.87	31.41	339.75	47.9
8/18/95	3:30:00	3360.00	31.92	-12.44	34.26	338.71	48.7
8/18/95	3:40:00	3370.00	31.19	-10.27	32.84	341.78	48.0
8/18/95	3:50:00	3380.00	34.53	-15.77	37.96	335.46	47.9
8/18/95	4:00:00	3390.00	29.83	-10.79	31.73	340.12	48.1
8/18/95	4:10:00	3400.00	35.25	-14.65	38.18	337.44	48.0
8/18/95	4:20:00	3410.00	32.96	-10.55	34.61	342.26	48.4
8/18/95	4:30:00	3420.00	32.84	-15.09	36.14	335.33	49.5
8/18/95	4:40:00	3430.00	29.34	-10.99	31.33	339.47	49.0
8/18/95	4:50:00	3440.00	29.46	-10.03	31.12	341.21	48.2
8/18/95	5:00:00	3450.00	27.01	-9.14	28.52	341.31	48.6
8/18/95	5:10:00	3460.00	23.76	-8.98	25.40	339.30	49.1
8/18/95	5:20:00	3470.00	21.11	-7.34	22.35	340.84	49.2
8/18/95	5:30:00	3480.00	22.83	-11.31	25.48	333.66	49.4
8/18/95	5:40:00	3490.00	19.98	-9.99	22.34	333.45	49.5
8/18/95	5:50:00	3500.00	20.86	-8.46	22.51	337.93	49.5
8/18/95	6:00:01	3510.00	29.02	-9.63	30.58	341.65	49.4
8/18/95	6:10:00	3520.00	22.55	-12.16	25.62	331.67	48.2
8/18/95	6:20:00	3530.00	20.18	-12.36	23.67	328.52	48.1
8/18/95	6:30:00	3540.00	24.48	-11.76	27.16	334.35	48.2
8/18/95	6:40:00	3550.00	24.88	-10.39	26.97	337.34	48.1
8/18/95	6:50:00	3560.00	20.22	-13.72	24.44	325.85	47.8
8/18/95	7:00:00	3570.00	14.47	-7.98	16.53	331.14	47.9
8/18/95	7:10:00	3580.00	10.58	-5.04	11.72	334.55	48.0
8/18/95	7:20:00	3590.00	9.05	-3.84	9.83	337.03	47.9

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/18/95	7:30:00	3600.00	7.04	-3.60	7.91	332.95	48.0
8/18/95	7:40:00	3610.00	1.33	-3.32	3.58	291.92	48.1
8/18/95	7:50:00	3620.00	-3.45	-1.87	3.92	208.46	48.0
8/18/95	8:00:00	3630.00	-3.57	-1.91	4.04	208.15	48.1
8/18/95	8:10:00	3640.00	-3.37	-1.07	3.53	197.60	48.1
8/18/95	8:20:00	3650.00	-3.33	-2.35	4.07	215.23	48.2
8/18/95	8:30:00	3660.00	-5.94	-1.91	6.23	197.82	48.1
8/18/95	8:40:00	3670.00	-3.69	0.82	3.78	167.42	48.1
8/18/95	8:50:00	3680.00	-9.56	4.44	10.54	155.07	48.1
8/18/95	9:00:01	3690.00	-10.80	5.64	12.18	152.41	48.1
8/18/95	9:10:00	3700.00	-10.40	5.85	11.93	150.62	48.2
8/18/95	9:20:00	3710.00	-10.56	5.12	11.73	154.11	48.1
8/18/95	9:30:00	3720.00	-9.96	3.15	10.44	162.43	48.2
8/18/95	9:40:00	3730.00	-13.37	7.25	15.21	151.51	48.9
8/18/95	9:50:00	3740.00	-14.10	5.81	15.25	157.59	48.7
8/18/95	10:00:00	3750.00	-13.74	6.01	14.99	156.36	48.7
8/18/95	10:10:00	3760.00	-13.54	10.31	17.02	142.70	48.9
8/18/95	10:20:00	3770.00	-23.26	10.87	25.67	154.94	47.6
8/18/95	10:30:01	3780.00	-33.27	12.68	35.60	159.13	45.7
8/18/95	10:40:00	3790.00	-30.09	13.08	32.81	156.50	45.8
8/18/95	10:50:00	3800.00	-29.49	14.53	32.87	153.76	45.9
8/18/95	11:00:00	3810.00	-37.97	19.07	42.49	153.33	45.3
8/18/95	11:10:00	3820.00	-36.32	23.81	43.43	146.75	44.1
8/18/95	11:20:00	3830.00	-38.57	24.41	45.64	147.67	25.1
8/18/95	11:30:00	3840.00	-38.81	25.50	46.43	146.69	38.7
8/18/95	11:40:00	3850.00	-38.01	21.60	43.72	150.39	27.2
8/18/95	11:50:00	3860.00	-45.64	29.60	54.40	147.03	53.1
8/18/95	12:00:01	3870.00	-41.38	25.50	48.60	148.35	39.5
8/18/95	12:10:00	3880.00	-37.20	21.92	43.17	149.49	53.1
8/18/95	12:20:00	3890.00	-40.18	25.42	47.54	147.67	53.1
8/18/95	12:30:00	3900.00	-37.49	21.36	43.14	150.32	31.3
8/18/95	12:40:00	3910.00	-35.08	21.32	41.05	148.70	55.4
8/18/95	12:50:00	3920.00	-34.71	19.95	40.03	150.10	56.5
8/18/95	13:00:00	3930.00	-37.45	23.41	44.16	147.98	57.5
8/18/95	13:10:00	3940.00	-31.86	18.91	37.05	149.30	40.6
8/18/95	13:20:00	3950.00	-32.70	22.60	39.75	145.34	58.8
8/18/95	13:30:01	3960.00	-32.38	19.71	37.90	148.66	59.7
8/18/95	13:40:00	3970.00	-33.43	19.59	38.74	149.62	59.6
8/18/95	13:50:00	3980.00	-37.77	23.37	44.41	148.25	37.4
8/18/95	14:00:00	3990.00	-33.47	20.96	39.49	147.94	61.1
8/18/95	14:10:00	4000.00	-30.49	16.37	34.60	151.76	56.1
8/18/95	14:20:00	4010.00	-36.60	21.52	42.45	149.54	60.9
8/18/95	14:30:00	4020.00	-31.66	19.47	37.16	148.40	61.0
8/18/95	14:40:00	4030.00	-29.57	17.90	34.56	148.80	61.8
8/18/95	14:50:00	4040.00	-34.95	17.82	39.23	152.98	62.2
8/18/95	15:00:00	4050.00	-34.11	19.87	39.47	149.77	62.4
8/18/95	15:10:00	4060.00	-29.41	20.35	35.76	145.31	61.9
8/18/95	15:20:00	4070.00	-32.54	18.26	37.31	150.69	61.7
8/18/95	15:30:00	4080.00	-31.78	18.06	36.55	150.38	61.5
8/18/95	15:40:00	4090.00	-33.27	22.48	40.15	145.95	62.0

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/18/95	15:50:00	4100.00	-32.22	17.90	36.86	150.94	59.5
8/18/95	16:00:00	4110.00	-31.74	19.75	37.38	148.10	62.8
8/18/95	16:10:00	4120.00	-30.57	17.90	35.42	149.64	63.1
8/18/95	16:20:00	4130.00	-32.46	17.34	36.80	151.88	63.5
8/18/95	16:30:00	4140.00	-33.51	20.43	39.24	148.62	63.9
8/18/95	16:40:00	4150.00	-29.93	17.58	34.71	149.56	63.4
8/18/95	16:50:00	4160.00	-29.29	18.67	34.73	147.48	64.1
8/18/95	17:00:00	4170.00	-30.13	20.11	36.22	146.27	64.1
8/18/95	17:10:00	4180.00	-33.67	17.86	38.11	152.05	64.2
8/18/95	17:20:01	4190.00	-30.13	18.91	35.57	147.88	64.4
8/18/95	17:30:00	4200.00	-30.73	17.86	35.54	149.83	64.6
8/18/95	17:40:00	4210.00	-25.87	13.80	29.32	151.91	64.6
8/18/95	17:50:00	4220.00	-28.44	17.26	33.26	148.74	64.6
8/18/95	18:00:00	4230.00	-29.69	14.33	32.96	154.23	64.9
8/18/95	18:10:00	4240.00	-25.39	13.00	28.52	152.88	65.5
8/18/95	18:20:00	4250.00	-27.68	14.33	31.17	152.62	65.5
8/18/95	18:30:00	4260.00	-26.68	15.61	30.91	149.66	65.5
8/18/95	18:40:00	4270.00	-23.82	15.21	28.26	147.43	65.0
8/18/95	18:50:01	4280.00	-24.95	15.53	29.39	148.09	64.8
8/18/95	19:00:00	4290.00	-23.66	16.37	28.77	145.31	64.4
8/18/95	19:10:00	4300.00	-24.02	13.60	27.60	150.47	64.4
8/18/95	19:20:00	4310.00	-23.54	9.74	25.47	157.51	64.3
8/18/95	19:30:00	4320.00	-19.12	10.47	21.80	151.28	64.7
8/18/95	19:40:01	4330.00	-19.20	10.43	21.85	151.48	64.6
8/18/95	19:50:00	4340.00	-14.54	8.06	16.62	150.98	64.7
8/18/95	20:00:00	4350.00	-16.51	8.10	18.39	153.85	64.8
8/18/95	20:10:00	4360.00	-16.15	5.81	17.16	160.20	64.3
8/18/95	20:20:00	4370.00	-13.33	6.57	14.86	153.75	64.5
8/18/95	20:30:00	4380.00	-11.73	6.33	13.33	151.63	64.8
8/18/95	20:40:00	4390.00	-12.05	5.00	13.04	157.45	64.2
8/18/95	20:50:00	4400.00	-10.80	5.32	12.04	153.76	64.6
8/18/95	21:00:00	4410.00	-11.61	2.91	11.96	165.91	64.7
8/18/95	21:10:00	4420.00	-7.91	3.43	8.62	156.53	64.4
8/18/95	21:20:00	4430.00	-8.43	1.06	8.49	172.81	64.3
8/18/95	21:30:00	4440.00	-2.64	1.47	3.02	150.81	64.6
8/18/95	21:40:00	4450.00	-2.60	-0.14	2.60	183.04	64.8
8/18/95	21:50:00	4460.00	-0.72	-1.59	1.74	245.76	64.5
8/18/95	22:00:01	4470.00	0.33	-2.23	2.25	278.55	64.4
8/18/95	22:10:00	4480.00	3.70	-5.29	6.46	305.02	64.4
8/18/95	22:20:00	4490.00	5.83	-7.17	9.24	309.15	64.7
8/18/95	22:30:00	4500.00	5.47	-8.70	10.28	302.19	64.5
8/18/95	22:40:00	4510.00	6.56	-5.08	8.30	322.28	64.4
8/18/95	22:50:01	4520.00	8.49	-6.93	10.96	320.80	64.4
8/18/95	23:00:00	4530.00	9.97	-9.10	13.50	317.63	64.0
8/18/95	23:10:00	4540.00	15.12	-6.89	16.62	335.52	64.4
8/18/95	23:20:00	4550.00	16.56	-6.21	17.69	339.46	64.2
8/18/95	23:30:00	4560.00	23.15	-12.08	26.12	332.45	64.2
8/18/95	23:40:00	4570.00	19.14	-8.02	20.76	337.28	64.3
8/18/95	23:50:00	4580.00	22.51	-11.84	25.44	332.27	64.2
8/19/95	0:00:00	4590.00	24.00	-6.93	24.98	343.90	64.3

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/19/95	0:10:00	4600.00	40.96	-21.40	46.22	332.42	63.8
8/19/95	0:20:00	4610.00	40.03	-27.59	48.62	325.43	64.0
8/19/95	0:30:00	4620.00	31.83	-19.19	37.17	328.92	64.0
8/19/95	0:40:00	4630.00	26.41	-9.59	28.10	340.05	63.9
8/19/95	0:50:00	4640.00	20.90	-11.11	23.67	332.02	63.8
8/19/95	1:00:00	4650.00	21.95	-15.25	26.73	325.22	63.6
8/19/95	1:10:01	4660.00	31.07	-9.02	32.36	343.82	63.0
8/19/95	1:20:00	4670.00	30.43	-9.71	31.95	342.31	63.3
8/19/95	1:30:00	4680.00	31.07	-9.59	32.52	342.85	62.9
8/19/95	1:40:00	4690.00	35.77	-11.27	37.51	342.52	62.8
8/19/95	1:50:00	4700.00	37.82	-10.27	39.19	344.81	63.6
8/19/95	2:00:00	4710.00	35.85	-9.22	37.02	345.58	63.1
8/19/95	2:10:00	4720.00	34.49	-11.84	36.47	341.06	63.1
8/19/95	2:20:00	4730.00	35.77	-12.56	37.91	340.66	63.9
8/19/95	2:30:00	4740.00	36.05	-13.48	38.49	339.50	63.5
8/19/95	2:40:01	4750.00	35.57	-14.81	38.53	337.40	63.3
8/19/95	2:50:00	4760.00	36.26	-14.01	38.88	338.88	63.2
8/19/95	3:00:00	4770.00	35.85	-15.41	39.03	336.75	64.1
8/19/95	3:10:00	4780.00	32.80	-14.05	35.69	336.82	64.2
8/19/95	3:20:00	4790.00	34.89	-15.53	38.19	336.01	64.9
8/19/95	3:30:00	4800.00	33.68	-14.57	36.70	336.61	63.6
8/19/95	3:40:00	4810.00	35.45	-16.82	39.24	334.62	64.2
8/19/95	3:50:00	4820.00	39.07	-14.81	41.79	339.25	64.2
8/19/95	4:00:00	4830.00	36.46	-16.06	39.84	336.23	64.1
8/19/95	4:10:01	4840.00	31.79	-12.40	34.13	338.70	64.6
8/19/95	4:20:00	4850.00	31.92	-12.56	34.31	338.53	64.8
8/19/95	4:30:00	4860.00	30.43	-14.69	33.79	334.24	64.9
8/19/95	4:40:00	4870.00	35.33	-13.68	37.89	338.84	65.0
8/19/95	4:50:00	4880.00	37.06	-14.89	39.94	338.12	64.2
8/19/95	5:00:00	4890.00	33.48	-15.45	36.88	335.23	65.0
8/19/95	5:10:00	4900.00	33.12	-15.01	36.37	335.63	65.4
8/19/95	5:20:00	4910.00	33.96	-13.85	36.68	337.82	65.5
8/19/95	5:30:00	4920.00	32.76	-13.40	35.40	337.76	65.9
8/19/95	5:40:01	4930.00	32.72	-16.02	36.43	333.92	65.4
8/19/95	5:50:00	4940.00	32.96	-14.41	35.98	336.39	65.0
8/19/95	6:00:00	4950.00	28.94	-12.52	31.54	336.61	65.2
8/19/95	6:10:00	4960.00	26.45	-10.91	28.62	337.59	66.0
8/19/95	6:20:00	4970.00	29.22	-11.59	31.44	338.37	65.9
8/19/95	6:30:00	4980.00	26.49	-12.00	29.08	335.64	65.7
8/19/95	6:40:00	4990.00	24.36	-10.83	26.66	336.04	65.6
8/19/95	6:50:00	5000.00	23.07	-9.22	24.85	338.22	65.6
8/19/95	7:00:00	5010.00	24.24	-9.47	26.03	338.67	65.6
8/19/95	7:10:00	5020.00	19.14	-8.22	20.83	336.77	65.4
8/19/95	7:20:00	5030.00	23.23	-8.90	24.88	339.05	65.3
8/19/95	7:30:00	5040.00	17.61	-9.34	19.94	332.07	65.5
8/19/95	7:40:00	5050.00	17.29	-8.38	19.22	334.15	65.6
8/19/95	7:50:00	5060.00	18.77	-6.77	19.96	340.18	65.6
8/19/95	8:00:00	5070.00	13.39	-7.66	15.43	330.24	65.5
8/19/95	8:10:00	5080.00	14.80	-6.29	16.08	336.99	65.3
8/19/95	8:20:00	5090.00	12.22	-5.69	13.48	335.05	65.1

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/19/95	8:30:00	5100.00	10.50	-4.76	11.53	335.63	65.1
8/19/95	8:40:00	5110.00	11.34	-4.28	12.12	339.34	65.5
8/19/95	8:50:00	5120.00	9.89	-4.88	11.03	333.76	65.9
8/19/95	9:00:00	5130.00	7.52	-4.76	8.90	327.70	65.5
8/19/95	9:10:00	5140.00	6.32	-5.57	8.43	318.64	65.2
8/19/95	9:20:00	5150.00	1.45	-3.04	3.37	295.59	65.8
8/19/95	9:30:01	5160.00	-2.93	-5.21	5.97	240.68	65.7
8/19/95	9:40:00	5170.00	-5.06	-3.16	5.96	211.99	65.8
8/19/95	9:50:00	5180.00	-5.30	-1.51	5.51	195.89	65.3
8/19/95	10:00:00	5190.00	-7.87	1.43	7.99	169.68	65.7
8/19/95	10:10:00	5200.00	-15.79	3.72	16.22	166.73	65.9
8/19/95	10:20:00	5210.00	-19.48	8.02	21.06	157.61	65.8
8/19/95	10:30:00	5220.00	-24.91	11.07	27.26	156.03	65.8
8/19/95	10:40:00	5230.00	-25.19	10.59	27.32	157.19	65.7
8/19/95	10:50:00	5240.00	-25.71	7.45	26.76	163.83	64.1
8/19/95	11:00:01	5250.00	-31.46	18.87	36.68	149.04	62.3
8/19/95	11:10:00	5260.00	-31.70	19.75	37.35	148.07	54.4
8/19/95	11:20:00	5270.00	-33.91	23.25	41.11	145.56	35.3
8/19/95	11:30:00	5280.00	-34.55	24.33	42.25	144.84	21.7
8/19/95	11:40:00	5290.00	-32.95	24.61	41.12	143.24	25.8
8/19/95	11:50:00	5300.00	-40.82	27.99	49.49	145.56	65.2
8/19/95	12:00:00	5310.00	-44.16	27.47	52.00	148.11	63.6
8/19/95	12:56:21	5370.00	-35.80	24.21	43.21	145.93	66.5
8/19/95	13:15:00	5385.00	-32.38	23.45	39.98	144.08	34.5
8/19/95	13:30:00	5400.00	-33.31	21.28	39.52	147.42	29.5
8/19/95	13:45:00	5415.00	-32.99	19.35	38.24	149.60	24.4
8/19/95	14:00:00	5430.00	-33.91	22.64	40.77	146.26	76.2
8/19/95	14:15:00	5445.00	-25.79	20.92	33.21	140.94	76.6
8/19/95	14:30:00	5460.00	-31.26	17.82	35.98	150.31	41.3
8/19/95	14:45:00	5475.00	-35.03	19.43	40.05	150.98	73.5
8/19/95	15:00:00	5490.00	-31.54	18.50	36.56	149.60	72.6
8/19/95	15:15:00	5505.00	-30.90	19.99	36.80	147.09	78.1
8/19/95	15:30:00	5520.00	-29.53	18.54	34.86	147.87	67.4
8/19/95	15:45:00	5535.00	-32.99	18.34	37.74	150.92	50.6
8/19/95	16:00:00	5550.00	-35.52	20.84	41.18	149.59	49.9
8/19/95	16:15:00	5565.00	-34.47	15.45	37.77	155.85	79.0
8/19/95	16:30:00	5580.00	-33.47	20.19	39.08	148.89	79.5
8/19/95	16:45:00	5595.00	-32.86	17.82	37.38	151.52	77.5
8/19/95	17:00:00	5610.00	-28.32	17.38	33.22	148.45	79.8
8/19/95	17:15:00	5625.00	-33.11	15.53	36.57	154.86	80.0
8/19/95	17:30:00	5640.00	-29.53	17.90	34.53	148.77	80.9
8/19/95	17:45:00	5655.00	-31.78	16.33	35.73	152.80	80.1
8/19/95	18:00:00	5670.00	-25.55	15.77	30.02	148.31	80.1
8/19/95	18:15:00	5685.00	-30.45	15.93	34.36	152.38	79.5
8/19/95	18:30:00	5700.00	-27.84	14.41	31.34	152.63	79.8
8/19/95	18:45:00	5715.00	-28.00	16.66	32.58	149.24	80.0
8/19/95	19:00:00	5730.00	-25.87	14.12	29.47	151.37	80.4
8/19/95	19:15:00	5745.00	-28.00	10.99	30.08	158.56	79.9
8/19/95	19:30:01	5760.00	-25.11	13.44	28.48	151.83	78.9
8/19/95	19:45:00	5775.00	-26.39	12.44	29.17	154.75	78.9

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/19/95	20:00:00	5790.00	-27.76	13.16	30.72	154.63	79.0
8/19/95	20:15:00	5805.00	-23.46	14.00	27.32	149.16	77.8
8/19/95	20:30:00	5820.00	-25.63	11.99	28.29	154.92	78.5
8/19/95	20:45:01	5835.00	-23.54	13.72	27.24	149.76	78.1
8/19/95	21:00:00	5850.00	-19.68	10.55	22.33	151.79	78.2
8/19/95	21:15:00	5865.00	-18.20	7.90	19.84	156.52	79.1
8/19/95	21:30:00	5880.00	-15.50	6.97	16.99	155.77	78.5
8/19/95	21:45:00	5895.00	-13.62	7.45	15.52	151.31	78.4
8/19/95	22:00:00	5910.00	-13.70	6.17	15.02	155.74	78.1
8/19/95	22:15:00	5925.00	-13.13	3.88	13.69	163.52	78.3
8/19/95	22:30:00	5940.00	-11.53	4.56	12.40	158.40	78.0
8/19/95	22:45:00	5955.00	-7.63	3.31	8.31	156.52	78.0
8/19/95	23:00:00	5970.00	-10.92	7.29	13.13	146.25	78.1
8/19/95	23:15:00	5985.00	-7.11	0.30	7.11	177.56	78.0
8/19/95	23:30:00	6000.00	-7.99	1.51	8.13	169.28	77.8
8/19/95	23:45:00	6015.00	-13.05	1.55	13.14	173.21	77.8
8/20/95	0:00:00	6030.00	-22.42	11.27	25.09	153.30	77.9
8/20/95	0:15:01	6045.00	-24.18	10.19	26.24	157.14	78.0
8/20/95	0:30:00	6060.00	-26.23	14.65	30.04	150.81	78.2
8/20/95	0:45:00	6075.00	-19.72	9.54	21.90	154.17	78.5
8/20/95	1:00:00	6090.00	-18.52	6.57	19.65	160.46	78.9
8/20/95	1:15:00	6105.00	-18.68	9.70	21.04	152.55	78.5
8/20/95	1:30:00	6120.00	-11.45	3.19	11.88	164.42	79.0
8/20/95	1:45:00	6135.00	0.53	-6.01	6.03	275.09	79.0
8/20/95	2:00:00	6150.00	17.25	-6.73	18.52	338.70	79.2
8/20/95	2:15:00	6165.00	33.08	-7.05	33.83	347.97	79.0
8/20/95	2:30:00	6180.00	43.41	-7.01	43.98	350.83	78.7
8/20/95	2:45:00	6195.00	47.39	-6.61	47.85	352.06	79.8
8/20/95	3:00:00	6210.00	37.46	-7.21	38.15	349.11	81.2
8/20/95	3:15:00	6225.00	43.01	-7.13	43.60	350.59	82.1
8/20/95	3:30:00	6240.00	38.14	-7.21	38.82	349.30	82.3
8/20/95	3:45:00	6255.00	35.05	-7.09	35.76	348.57	83.5
8/20/95	4:00:00	6270.00	35.85	-7.17	36.56	348.70	83.1
8/20/95	4:15:00	6285.00	44.98	-7.13	45.55	351.00	83.7
8/20/95	4:30:00	6300.00	40.84	-7.17	41.47	350.05	83.7
8/20/95	4:45:00	6315.00	42.89	-7.21	43.50	350.46	83.6
8/20/95	5:00:00	6330.00	42.40	-7.17	43.01	350.41	84.1
8/20/95	5:15:00	6345.00	53.33	-7.30	53.83	352.21	84.6
8/20/95	5:30:00	6360.00	51.77	-7.17	52.27	352.12	84.5
8/20/95	5:45:00	6375.00	41.64	-7.34	42.29	350.01	84.6
8/20/95	6:00:01	6390.00	40.03	-7.17	40.67	349.85	84.4
8/20/95	6:15:00	6405.00	45.62	-7.86	46.30	350.23	85.0
8/20/95	6:30:00	6420.00	44.21	-7.34	44.82	350.58	84.5
8/20/95	6:45:00	6435.00	39.79	-7.09	40.42	349.90	85.1
8/20/95	7:00:00	6450.00	42.08	-7.13	42.68	350.39	85.3
8/20/95	7:15:00	6465.00	38.30	-7.13	38.96	349.46	85.5
8/20/95	7:30:00	6480.00	38.43	-7.09	39.08	349.55	85.4
8/20/95	7:45:00	6495.00	40.43	-7.30	41.09	349.77	84.8
8/20/95	8:00:00	6510.00	45.78	-7.09	46.33	351.20	85.2
8/20/95	8:15:01	6525.00	35.05	-7.09	35.76	348.57	84.9

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/20/95	8:30:00	6540.00	35.49	-7.13	36.20	348.65	85.1
8/20/95	8:45:00	6555.00	39.19	-7.17	39.84	349.64	84.9
8/20/95	9:00:00	6570.00	34.73	-7.09	35.45	348.47	85.3
8/20/95	9:15:00	6585.00	26.09	-7.05	27.03	344.89	85.1
8/20/95	9:30:00	6600.00	27.41	-7.09	28.32	345.50	85.0
8/20/95	9:45:00	6615.00	27.05	-6.97	27.94	345.56	85.0
8/20/95	10:00:00	6630.00	21.55	-6.97	22.65	342.09	85.0
8/20/95	10:15:00	6645.00	12.14	-6.85	13.94	330.58	85.3
8/20/95	10:30:01	6660.00	5.31	-6.61	8.48	308.81	84.8
8/20/95	10:45:00	6675.00	-4.37	-6.81	8.09	237.33	85.6
8/20/95	11:00:00	6690.00	-9.03	-6.37	11.05	215.21	85.6
8/20/95	11:15:00	6705.00	-13.90	-6.81	15.47	206.10	85.1
8/20/95	11:30:00	6720.00	-18.84	-6.69	19.99	199.55	85.3
8/20/95	11:45:00	6735.00	-21.57	-6.53	22.53	196.84	85.5
8/20/95	12:00:00	6750.00	-20.17	-6.97	21.33	199.06	84.1
8/20/95	12:15:00	6765.00	-24.35	-6.65	25.24	195.27	83.2
8/20/95	12:30:00	6780.00	-30.53	-6.97	31.31	192.86	82.8
8/20/95	12:45:01	6795.00	-30.25	-6.65	30.97	192.40	37.8
8/20/95	13:00:00	6810.00	-32.38	-6.57	33.03	191.47	45.9
8/20/95	13:15:00	6825.00	-33.79	-6.05	34.32	190.15	22.4
8/20/95	13:30:00	6840.00	-40.90	-5.73	41.29	187.97	76.5
8/20/95	13:45:00	6855.00	-41.99	-4.68	42.24	186.36	22.7
8/20/95	14:00:00	6870.00	-42.75	-4.92	43.03	186.56	34.1
8/20/95	14:15:00	6885.00	-40.02	-4.04	40.22	185.76	80.7
8/20/95	14:30:00	6900.00	-37.89	19.75	42.73	152.46	82.1
8/20/95	14:45:00	6915.00	-38.53	18.95	42.93	153.81	83.3
8/20/95	15:00:00	6930.00	-30.69	12.76	33.23	157.42	83.6
8/20/95	15:15:00	6945.00	-35.40	20.27	40.79	150.20	83.7
8/20/95	15:30:00	6960.00	-31.46	11.75	33.58	159.51	84.4
8/20/95	15:45:00	6975.00	-32.90	17.94	37.47	151.39	84.8
8/20/95	16:00:00	6990.00	-37.77	3.11	37.89	175.29	84.9
8/20/95	16:15:00	7005.00	-34.03	-7.17	34.77	191.90	86.5
8/20/95	16:30:00	7020.00	-30.45	-7.05	31.25	193.03	85.9
8/20/95	16:45:00	7035.00	-32.86	-6.49	33.49	191.17	85.9
8/20/95	17:00:00	7050.00	-25.39	-6.69	26.25	194.76	86.1
8/20/95	17:15:00	7065.00	-27.00	-6.85	27.85	194.23	86.7
8/20/95	17:30:00	7080.00	-34.19	-6.61	34.82	190.94	87.0
8/20/95	17:45:00	7095.00	-30.33	-6.77	31.07	192.58	86.9
8/20/95	18:00:00	7110.00	-30.69	-6.57	31.38	192.08	88.4
8/20/95	18:15:00	7125.00	-29.77	-6.69	30.51	192.66	88.3
8/20/95	18:30:01	7140.00	-30.13	-6.77	30.88	192.66	88.0
8/20/95	18:45:00	7155.00	-24.43	-6.45	25.26	194.79	87.8
8/20/95	19:00:00	7170.00	-27.32	-6.93	28.18	194.23	88.2
8/20/95	19:15:00	7185.00	-23.42	-6.61	24.33	195.76	88.9
8/20/95	19:30:00	7200.00	-22.38	-6.65	23.34	196.55	89.5
8/20/95	19:45:00	7215.00	-22.50	-6.45	23.40	195.99	88.2
8/20/95	20:00:00	7230.00	-23.26	-6.29	24.09	195.13	88.3
8/20/95	20:15:00	7245.00	-21.85	-6.61	22.82	196.83	88.7
8/20/95	20:30:00	7260.00	-19.60	-6.17	20.54	197.47	89.3
8/20/95	20:45:00	7275.00	-18.12	-6.05	19.10	198.46	89.0

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/20/95	21:00:00	7290.00	-14.18	-5.85	15.33	202.42	89.5
8/20/95	21:15:00	7305.00	-16.15	-6.37	17.36	201.52	89.1
8/20/95	21:30:00	7320.00	-12.65	-6.13	14.05	205.85	89.1
8/20/95	21:45:00	7335.00	-13.98	-6.21	15.29	203.95	89.1
8/20/95	22:00:00	7350.00	-13.74	-6.01	14.99	203.62	88.8
8/20/95	22:15:00	7365.00	-8.75	-6.33	10.79	215.89	88.9
8/20/95	22:30:00	7380.00	-4.41	-6.21	7.61	234.64	88.9
8/20/95	22:45:00	7395.00	-1.24	-6.09	6.21	258.53	88.8
8/20/95	23:00:00	7410.00	0.45	-6.21	6.22	274.19	89.1
8/20/95	23:15:01	7425.00	-2.04	-2.51	3.23	230.94	89.1
8/20/95	23:30:00	7440.00	-0.88	-5.97	6.03	261.66	89.0
8/20/95	23:45:00	7455.00	0.73	-6.13	6.17	276.84	88.9
8/21/95	0:00:00	7470.00	7.08	-5.61	9.04	321.64	89.1
8/21/95	0:15:00	7485.00	13.35	-5.77	14.55	336.64	89.1
8/21/95	0:30:00	7500.00	18.49	-5.61	19.33	343.13	89.4
8/21/95	0:45:00	7515.00	20.30	-5.69	21.09	344.35	89.3
8/21/95	1:00:00	7530.00	25.93	-5.85	26.59	347.29	88.1
8/21/95	1:15:00	7545.00	31.03	-5.69	31.55	349.61	87.7
8/21/95	1:30:00	7560.00	31.71	-5.49	32.19	350.18	88.4
8/21/95	1:45:00	7575.00	29.95	-5.69	30.49	349.25	88.7
8/21/95	2:00:00	7590.00	23.36	-5.33	23.96	347.15	88.7
8/21/95	2:15:00	7605.00	38.47	-6.41	39.00	350.54	89.1
8/21/95	2:30:00	7620.00	39.75	-7.17	40.40	349.78	87.8
8/21/95	2:45:00	7635.00	35.69	-8.46	36.68	346.67	88.2
8/21/95	3:00:00	7650.00	42.28	-9.22	43.28	347.70	89.6
8/21/95	3:15:00	7665.00	45.34	-9.51	46.33	348.16	90.8
8/21/95	3:30:00	7680.00	45.94	-10.63	47.16	346.98	90.8
8/21/95	3:45:00	7695.00	43.89	-11.68	45.42	345.10	91.3
8/21/95	4:00:00	7710.00	43.17	-12.20	44.86	344.22	91.7
8/21/95	4:15:00	7725.00	47.35	-15.61	49.86	341.76	93.0
8/21/95	4:30:00	7740.00	51.57	-14.09	53.46	344.72	93.3
8/21/95	4:45:00	7755.00	41.36	-14.21	43.74	341.04	93.1
8/21/95	5:00:00	7770.00	40.51	-13.76	42.79	341.24	93.9
8/21/95	5:15:00	7785.00	41.08	-17.02	44.47	337.50	93.0
8/21/95	5:30:00	7800.00	37.26	-15.89	40.51	336.91	93.7
8/21/95	5:45:00	7815.00	41.16	-12.56	43.04	343.04	93.3
8/21/95	6:00:00	7830.00	40.11	-13.85	42.44	340.96	93.9
8/21/95	6:15:00	7845.00	39.95	-14.65	42.56	339.87	93.6
8/21/95	6:30:00	7860.00	40.56	-18.71	44.67	335.24	93.3
8/21/95	6:45:00	7875.00	40.88	-19.99	45.51	333.95	93.8
8/21/95	7:00:00	7890.00	35.37	-15.73	38.71	336.03	94.0
8/21/95	7:15:01	7905.00	47.67	-18.19	51.03	339.12	93.9
8/21/95	7:30:00	7920.00	40.31	-21.28	45.59	332.18	93.5
8/21/95	7:45:00	7935.00	47.55	-19.79	51.51	337.41	93.3
8/21/95	8:00:00	7950.00	40.76	-15.81	43.72	338.80	94.3
8/21/95	8:15:00	7965.00	40.84	-8.50	41.72	348.25	93.9
8/21/95	8:30:00	7980.00	46.14	-6.81	46.64	351.61	94.6
8/21/95	8:45:00	7995.00	50.84	-6.93	51.31	352.24	94.4
8/21/95	9:00:00	8010.00	38.59	-6.85	39.20	349.94	94.4
8/21/95	9:15:00	8025.00	34.69	-7.17	35.43	348.33	94.1

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/21/95	9:30:01	8040.00	27.05	-6.85	27.91	345.80	94.3
8/21/95	9:45:00	8055.00	29.46	-6.73	30.22	347.14	94.0
8/21/95	10:00:00	8070.00	27.41	-6.69	28.22	346.29	93.6
8/21/95	10:15:00	8085.00	20.74	-6.09	21.62	343.65	92.7
8/21/95	10:30:00	8100.00	13.71	-9.71	16.80	324.71	92.5
8/21/95	10:45:00	8115.00	6.88	-7.38	10.09	313.02	92.6
8/21/95	11:00:00	8130.00	2.22	-3.88	4.47	299.85	93.6
8/21/95	11:15:00	8145.00	-6.70	-1.03	6.77	188.73	92.7
8/21/95	11:30:00	8160.00	-12.01	0.78	12.03	176.27	92.6
8/21/95	11:45:01	8175.00	-18.72	7.29	20.09	158.71	93.6
8/21/95	12:00:00	8190.00	-25.51	9.38	27.18	159.80	93.6
8/21/95	12:15:00	8205.00	-22.74	9.42	24.61	157.49	93.3
8/21/95	12:30:00	8220.00	-22.74	5.93	23.50	165.38	93.1
8/21/95	12:45:00	8235.00	-25.79	8.62	27.19	161.51	92.0
8/21/95	13:00:00	8250.00	-26.07	6.65	26.90	165.68	90.6
8/21/95	13:15:00	8265.00	-27.60	10.47	29.52	159.22	90.5
8/21/95	13:30:00	8280.00	-38.05	17.14	41.73	155.74	89.6
8/21/95	13:45:00	8295.00	-38.97	26.18	46.94	146.10	88.0
8/21/95	14:00:00	8310.00	-37.29	24.65	44.70	146.53	84.6
8/21/95	14:15:00	8325.00	-39.66	26.06	47.45	146.69	71.5
8/21/95	14:30:00	8340.00	-39.05	27.14	47.55	145.19	87.9
8/21/95	14:45:00	8355.00	-38.09	23.73	44.87	148.07	55.4
8/21/95	15:00:00	8370.00	-37.00	18.58	41.40	153.33	34.5
8/21/95	15:15:00	8385.00	-40.62	21.24	45.83	152.39	24.4
8/21/95	15:30:00	8400.00	-37.29	22.32	43.46	149.09	44.7
8/21/95	15:45:00	8415.00	-36.40	19.75	41.41	151.51	93.5
8/21/95	16:00:00	8430.00	-36.12	18.62	40.63	152.72	95.2
8/21/95	16:15:00	8445.00	-35.36	18.14	39.74	152.84	94.9
8/21/95	16:28:16	8460.00	-37.53	22.56	43.79	148.98	96.1
8/21/95	17:15:00	8505.00	-40.02	20.63	45.02	152.72	98.2
8/21/95	17:30:00	8520.00	-33.99	20.47	39.67	148.94	34.3
8/21/95	17:45:00	8535.00	-35.28	17.22	39.25	153.98	98.9
8/21/95	18:00:00	8550.00	-30.73	14.57	34.01	154.63	98.9
8/21/95	18:15:00	8565.00	-29.45	13.20	32.27	155.85	99.7
8/21/95	18:30:00	8580.00	-30.49	16.17	34.51	152.05	99.7
8/21/95	18:45:00	8595.00	-31.98	16.17	35.83	153.17	99.7
8/21/95	18:58:25	8610.00	-34.35	16.13	37.95	154.84	89.8
8/21/95	19:15:00	8625.00	-36.28	19.51	41.19	151.72	100.2
8/21/95	19:30:00	8640.00	-35.28	18.26	39.72	152.63	99.4
8/21/95	19:45:00	8655.00	-31.58	14.97	34.94	154.63	100.2
8/21/95	20:00:00	8670.00	-36.56	16.62	40.16	155.55	100.3
8/21/95	20:15:00	8685.00	-26.92	15.29	30.96	150.40	100.6
8/21/95	20:30:00	8700.00	-23.18	11.99	26.09	152.64	100.6
8/21/95	20:45:00	8715.00	-20.45	10.71	23.08	152.35	101.0
8/21/95	21:00:01	8730.00	-22.26	11.75	25.17	152.16	100.5
8/21/95	21:15:00	8745.00	-19.52	5.08	20.17	165.40	100.9
8/21/95	21:30:00	8760.00	-18.48	6.93	19.73	159.43	100.2
8/21/95	21:45:00	8775.00	-16.55	4.52	17.15	164.71	100.7
8/21/95	22:00:00	8790.00	-13.86	2.87	14.15	168.29	100.2
8/21/95	22:15:00	8805.00	-12.49	3.23	12.90	165.49	100.3

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/21/95	22:30:00	8820.00	-11.24	1.18	11.30	173.99	100.7
8/21/95	22:45:00	8835.00	-9.88	-0.74	9.90	184.27	100.2
8/21/95	23:00:00	8850.00	-10.88	-0.42	10.88	182.20	100.4
8/21/95	23:15:00	8865.00	-9.32	2.15	9.56	166.99	99.9
8/21/95	23:30:00	8880.00	-6.70	-1.55	6.87	193.02	100.3
8/21/95	23:45:00	8895.00	-9.11	-1.07	9.17	186.69	100.4
8/22/95	0:00:00	8910.00	-5.86	-1.27	5.99	192.22	100.7
8/22/95	0:15:00	8925.00	-0.76	-5.49	5.54	262.17	100.3
8/22/95	0:30:01	8940.00	2.62	-6.97	7.45	290.64	100.8
8/22/95	0:45:00	8955.00	2.74	-8.02	8.47	288.90	100.3
8/22/95	1:00:00	8970.00	10.74	-10.55	15.06	315.53	100.6
8/22/95	1:15:00	8985.00	15.12	-13.32	20.15	318.64	100.1
8/22/95	1:30:00	9000.00	19.34	-11.92	22.72	328.36	100.3
8/22/95	1:45:00	9015.00	18.33	-14.93	23.64	320.85	100.6
8/22/95	2:00:00	9030.00	20.14	-8.98	22.05	335.98	100.7
8/22/95	2:15:00	9045.00	21.79	-31.04	37.93	305.08	100.6
8/22/95	2:30:00	9060.00	30.35	-21.04	36.93	325.28	101.1
8/22/95	2:45:00	9075.00	18.21	-10.51	21.03	330.02	101.3
8/22/95	3:00:00	9090.00	26.53	-11.88	29.07	335.89	101.3
8/22/95	3:15:00	9105.00	25.69	-13.24	28.90	332.74	100.6
8/22/95	3:30:00	9120.00	34.09	-13.32	36.60	338.66	100.8
8/22/95	3:45:00	9135.00	40.39	-15.65	43.32	338.83	101.0
8/22/95	4:00:00	9150.00	39.47	-20.11	44.30	333.01	101.4
8/22/95	4:15:00	9165.00	32.00	-16.58	36.04	332.62	101.5
8/22/95	4:30:00	9180.00	41.32	-19.67	45.77	334.55	102.3
8/22/95	4:45:00	9195.00	38.30	-19.95	43.19	332.49	101.9
8/22/95	5:00:00	9210.00	33.92	-18.39	38.59	331.54	101.2
8/22/95	5:15:00	9225.00	38.47	-16.62	41.91	336.64	101.6
8/22/95	5:30:00	9240.00	39.91	-19.87	44.59	333.54	101.4
8/22/95	5:45:00	9255.00	39.07	-17.14	42.67	336.32	101.5
8/22/95	6:00:00	9270.00	38.51	-17.22	42.19	335.91	102.3
8/22/95	6:15:01	9285.00	37.10	-18.59	41.50	333.39	102.2
8/22/95	6:30:00	9300.00	35.65	-18.15	40.01	333.02	102.4
8/22/95	6:45:00	9315.00	38.99	-16.90	42.50	336.57	102.3
8/22/95	7:00:00	9330.00	38.47	-17.14	42.12	335.99	102.7
8/22/95	7:15:00	9345.00	40.68	-16.98	44.09	337.35	102.8
8/22/95	7:30:00	9360.00	32.64	-13.93	35.49	336.89	102.5
8/22/95	7:45:00	9375.00	36.05	-16.74	39.75	335.10	102.5
8/22/95	8:00:00	9390.00	35.85	-20.11	41.11	330.72	102.6
8/22/95	8:15:00	9405.00	30.35	-10.75	32.20	340.50	102.9
8/22/95	8:30:01	9420.00	33.52	-11.27	35.37	341.42	102.7
8/22/95	8:45:00	9435.00	32.36	-10.39	33.99	342.21	102.7
8/22/95	9:00:00	9450.00	32.04	-12.40	34.36	338.85	102.7
8/22/95	9:15:00	9465.00	31.79	-15.33	35.30	334.26	102.8
8/22/95	9:30:00	9480.00	29.62	-12.32	32.08	337.42	103.4
8/22/95	9:45:00	9495.00	27.01	-14.89	30.85	331.14	103.1
8/22/95	10:00:00	9510.00	24.76	-13.32	28.12	331.73	103.1
8/22/95	10:15:00	9525.00	27.25	-14.57	30.90	331.88	103.2
8/22/95	10:30:00	9540.00	22.23	-10.91	24.77	333.87	102.9
8/22/95	10:45:01	9555.00	18.01	-10.39	20.80	330.03	103.1

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/22/95	11:00:00	9570.00	14.72	-8.14	16.82	331.07	103.1
8/22/95	11:15:00	9585.00	13.83	-8.10	16.03	329.66	103.2
8/22/95	11:30:00	9600.00	5.31	-6.57	8.45	308.98	104.1
8/22/95	11:45:00	9615.00	-5.54	-2.47	6.06	204.03	103.9
8/22/95	12:00:00	9630.00	-12.53	0.90	12.56	175.88	103.2
8/22/95	12:15:00	9645.00	-16.03	9.10	18.43	150.40	104.5
8/22/95	12:30:00	9660.00	-23.10	9.94	25.14	156.71	103.1
8/22/95	12:45:00	9675.00	-22.58	3.64	22.87	170.83	103.6
8/22/95	13:00:01	9690.00	-20.33	4.36	20.79	167.89	103.6
8/22/95	13:15:00	9705.00	-18.48	8.18	20.21	156.11	103.1
8/22/95	13:30:00	9720.00	-32.78	11.27	34.66	161.02	101.1
8/22/95	13:45:00	9735.00	-35.68	12.92	37.94	160.09	98.0
8/22/95	14:00:00	9750.00	-39.74	20.23	44.59	153.02	97.8
8/22/95	14:15:00	9765.00	-38.81	24.49	45.89	147.74	99.1
8/22/95	14:30:00	9780.00	-42.51	31.89	53.14	143.12	43.8
8/22/95	14:45:00	9795.00	-44.28	35.22	56.58	141.50	32.8
8/22/95	15:00:00	9810.00	-42.55	23.09	48.41	151.51	21.4
8/22/95	15:15:00	9825.00	-44.40	21.32	49.25	154.35	104.8
8/22/95	15:30:00	9840.00	-38.49	25.78	46.32	146.18	104.8
8/22/95	15:45:00	9855.00	-43.39	23.33	49.26	151.73	105.1
8/22/95	16:00:00	9870.00	-36.92	20.23	42.10	151.27	104.8
8/22/95	16:15:00	9885.00	-40.62	28.39	49.56	145.04	104.9
8/22/95	16:30:00	9900.00	-37.33	20.15	42.42	151.63	104.2
8/22/95	16:45:00	9915.00	-39.74	21.40	45.13	151.69	104.5
8/22/95	17:00:00	9930.00	-40.22	19.43	44.66	154.21	105.0
8/22/95	17:15:00	9945.00	-37.16	23.41	43.92	147.78	104.8
8/22/95	17:30:00	9960.00	-37.00	19.87	41.99	151.76	104.8
8/22/95	17:45:00	9975.00	-38.89	20.11	43.78	152.65	104.6
8/22/95	18:00:00	9990.00	-37.69	19.75	42.55	152.34	104.9
8/22/95	18:15:00	10005.00	-33.47	21.16	39.59	147.69	104.9
8/22/95	18:30:00	10020.00	-34.51	16.29	38.16	154.72	104.8
8/22/95	18:45:01	10035.00	-36.12	19.99	41.28	151.03	104.8
8/22/95	19:00:00	10050.00	-34.11	16.37	37.83	154.36	104.8
8/22/95	19:15:00	10065.00	-36.88	19.15	41.55	152.55	105.1
8/22/95	19:30:00	10080.00	-31.62	16.98	35.89	151.76	104.8
8/22/95	19:45:00	10095.00	-32.54	16.82	36.63	152.66	104.9
8/22/95	20:00:00	10110.00	-33.75	18.38	38.43	151.42	104.8
8/22/95	20:15:00	10125.00	-32.82	15.01	36.09	155.42	104.6
8/22/95	20:30:00	10140.00	-30.49	13.20	33.22	156.58	104.6
8/22/95	20:45:00	10155.00	-29.77	15.85	33.72	151.96	104.7
8/22/95	21:00:00	10170.00	-24.47	11.91	27.21	154.04	104.6
8/22/95	21:15:00	10185.00	-24.27	9.94	26.22	157.72	104.7
8/22/95	21:30:00	10200.00	-23.94	9.86	25.89	157.61	104.8
8/22/95	21:45:00	10215.00	-20.25	8.22	21.85	157.90	104.5
8/22/95	22:00:00	10230.00	-19.56	3.96	19.95	168.55	104.5
8/22/95	22:15:00	10245.00	-15.38	4.12	15.92	164.99	104.6
8/22/95	22:30:00	10260.00	-13.21	0.90	13.24	176.09	105.1
8/22/95	22:45:00	10275.00	-15.02	1.95	15.14	172.59	104.7
8/22/95	23:00:00	10290.00	-13.98	2.47	14.19	169.97	104.6
8/22/95	23:15:00	10305.00	-15.30	4.36	15.90	164.08	105.3

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/22/95	23:30:01	10320.00	-16.07	4.24	16.62	165.21	104.6
8/22/95	23:45:00	10335.00	-16.03	3.60	16.42	167.33	104.4
8/23/95	0:00:00	10350.00	-10.24	-0.34	10.24	181.89	104.6
8/23/95	0:15:00	10365.00	-5.86	-2.91	6.54	206.41	104.6
8/23/95	0:30:00	10380.00	-2.52	-5.41	5.96	245.06	104.6
8/23/95	0:45:00	10395.00	1.25	-7.01	7.12	280.15	104.6
8/23/95	1:00:00	10410.00	5.23	-8.98	10.39	300.25	104.8
8/23/95	1:15:00	10425.00	11.30	-12.48	16.84	312.18	104.6
8/23/95	1:30:00	10440.00	18.41	-14.41	23.38	321.96	104.5
8/23/95	1:45:00	10455.00	22.15	-11.55	24.98	332.47	104.5
8/23/95	2:00:00	10470.00	19.10	-12.80	23.00	326.18	104.6
8/23/95	2:15:00	10485.00	16.81	-8.62	18.89	332.86	104.3
8/23/95	2:30:00	10500.00	29.02	-33.21	44.10	311.15	104.1
8/23/95	2:45:00	10515.00	30.91	-33.98	45.94	312.30	103.8
8/23/95	3:00:00	10530.00	28.54	-26.46	38.92	317.17	103.8
8/23/95	3:15:00	10545.00	25.53	-22.49	34.03	318.63	104.4
8/23/95	3:30:00	10560.00	25.36	-15.37	29.66	328.79	104.2
8/23/95	3:45:00	10575.00	25.57	-15.25	29.78	329.20	104.1
8/23/95	4:00:00	10590.00	29.87	-13.60	32.82	335.53	104.3
8/23/95	4:15:00	10605.00	36.98	-14.09	39.58	339.15	104.1
8/23/95	4:30:00	10620.00	29.18	-15.01	32.82	332.79	104.1
8/23/95	4:45:00	10635.00	31.67	-16.58	35.75	332.37	104.1
8/23/95	5:00:00	10650.00	33.64	-21.48	39.92	327.45	104.1
8/23/95	5:15:00	10665.00	30.87	-13.24	33.59	336.79	104.0
8/23/95	5:30:00	10680.00	34.29	-16.46	38.04	334.36	104.0
8/23/95	5:45:00	10695.00	35.69	-17.70	39.84	333.63	104.0
8/23/95	6:00:00	10710.00	37.82	-20.88	43.20	331.10	104.0
8/23/95	6:15:00	10725.00	36.98	-21.48	42.77	329.86	104.1
8/23/95	6:30:00	10740.00	36.05	-17.22	39.96	334.47	104.3
8/23/95	6:45:00	10755.00	36.30	-18.19	40.61	333.39	104.4
8/23/95	7:00:00	10770.00	39.87	-19.75	44.50	333.65	104.0
8/23/95	7:15:00	10785.00	42.24	-20.84	47.10	333.74	104.1
8/23/95	7:30:01	10800.00	36.30	-17.42	40.27	334.37	104.2
8/23/95	7:45:00	10815.00	37.62	-19.27	42.27	332.88	104.0
8/23/95	8:00:00	10830.00	35.45	-17.14	39.38	334.20	104.2
8/23/95	8:15:00	10845.00	40.68	-14.25	43.11	340.70	104.1
8/23/95	8:30:00	10860.00	41.00	-8.98	41.98	347.65	104.0
8/23/95	8:45:00	10875.00	39.71	-7.05	40.34	349.94	104.0
8/23/95	9:00:00	10890.00	39.67	-12.76	41.68	342.17	104.3
8/23/95	9:15:00	10905.00	35.81	-11.27	37.55	342.54	104.2
8/23/95	9:30:00	10920.00	29.95	-12.24	32.36	337.78	104.2
8/23/95	9:45:01	10935.00	28.46	-13.32	31.43	334.93	102.9
8/23/95	10:00:00	10950.00	28.94	-17.74	33.95	328.50	103.8
8/23/95	10:15:00	10965.00	25.81	-14.33	29.52	330.97	104.4
8/23/95	10:30:00	10980.00	22.23	-13.89	26.22	328.01	103.7
8/23/95	10:45:00	10995.00	22.71	-11.51	25.46	333.13	103.8
8/23/95	11:00:00	11010.00	20.38	-12.56	23.94	328.37	103.8
8/23/95	11:15:00	11025.00	11.10	-9.38	14.53	319.82	103.6
8/23/95	11:30:00	11040.00	10.29	-8.26	13.20	321.27	103.6
8/23/95	11:45:00	11055.00	4.99	-7.78	9.24	302.71	103.2

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/23/95	12:00:01	11070.00	-4.17	-2.71	4.97	213.03	103.5
8/23/95	12:15:00	11085.00	-10.60	0.38	10.60	177.93	104.0
8/23/95	12:30:00	11100.00	-12.45	-0.70	12.46	183.21	103.3
8/23/95	12:45:00	11115.00	-28.20	8.94	29.58	162.40	104.0
8/23/95	13:00:00	11130.00	-20.61	-0.10	20.61	180.27	103.1
8/23/95	13:15:00	11145.00	-17.43	4.68	18.04	164.96	103.1
8/23/95	13:30:00	11160.00	-19.48	8.50	21.25	156.42	103.3
8/23/95	13:45:00	11175.00	-32.42	11.03	34.24	161.20	102.9
8/23/95	14:00:00	11190.00	-36.80	13.92	39.34	159.27	102.9
8/23/95	14:15:00	11205.00	-37.61	21.52	43.33	150.22	103.1
8/23/95	14:30:01	11220.00	-40.50	28.47	49.50	144.89	55.1
8/23/95	14:45:00	11235.00	-44.68	30.24	53.95	145.90	50.7
8/23/95	15:00:00	11250.00	-43.03	26.90	50.74	147.98	17.4
8/23/95	15:15:00	11265.00	-44.68	27.43	52.43	148.45	23.4
8/23/95	15:30:00	11280.00	-48.90	26.14	55.44	151.87	103.1
8/23/95	15:45:00	11295.00	-45.68	27.43	53.28	149.01	103.4
8/23/95	16:00:00	11310.00	-45.20	27.10	52.70	149.05	105.9
8/23/95	16:15:00	11325.00	-46.49	22.88	51.81	153.79	105.9
8/23/95	16:30:00	11340.00	-41.10	22.08	46.65	151.75	106.5
8/23/95	16:45:01	11355.00	-39.90	19.43	44.38	154.03	106.5
8/23/95	17:00:00	11370.00	-40.06	18.34	44.05	155.40	106.6
8/23/95	17:15:00	11385.00	-40.54	19.99	45.20	153.75	106.8
8/23/95	17:30:00	11400.00	-41.63	21.04	46.64	153.18	106.2
8/23/95	17:45:00	11415.00	-36.28	22.97	42.94	147.65	106.5
8/23/95	18:00:00	11430.00	-35.24	21.12	41.08	149.06	106.9
8/23/95	18:15:00	11445.00	-35.68	18.99	40.42	151.97	106.9
8/23/95	18:30:00	11460.00	-33.31	15.49	36.73	155.05	107.0
8/23/95	18:45:00	11475.00	-34.39	20.35	39.96	149.38	106.7
8/23/95	19:00:00	11490.00	-31.02	14.04	34.05	155.64	106.7
8/23/95	19:15:00	11505.00	-32.30	14.85	35.55	155.30	106.8
8/23/95	19:30:00	11520.00	-32.70	16.41	36.58	153.34	106.5
8/23/95	19:45:00	11535.00	-33.07	13.48	35.71	157.82	106.8
8/23/95	20:00:00	11550.00	-29.93	13.24	32.72	156.13	106.8
8/23/95	20:15:01	11565.00	-27.84	10.67	29.81	159.02	106.9
8/23/95	20:30:00	11580.00	-25.31	12.40	28.18	153.89	107.0
8/23/95	20:45:00	11595.00	-23.50	10.15	25.59	156.63	106.7
8/23/95	21:00:00	11610.00	-22.34	8.14	23.77	159.97	106.5
8/23/95	21:15:00	11625.00	-21.45	7.29	22.65	161.22	106.7
8/23/95	21:30:01	11640.00	-19.16	7.61	20.61	158.33	106.7
8/23/95	21:45:00	11655.00	-19.20	4.16	19.64	167.77	107.0
8/23/95	22:00:00	11670.00	-16.87	1.51	16.93	174.88	106.5
8/23/95	22:15:00	11685.00	-21.13	6.85	22.21	162.03	106.7
8/23/95	22:30:00	11700.00	-18.84	6.21	19.83	161.75	106.7
8/23/95	22:45:00	11715.00	-19.28	7.77	20.78	158.04	107.0
8/23/95	23:00:00	11730.00	-19.32	4.80	19.90	166.04	107.0
8/23/95	23:15:00	11745.00	-16.47	2.39	16.64	171.73	106.7
8/23/95	23:30:00	11760.00	-12.89	-0.22	12.89	180.97	107.0
8/23/95	23:45:00	11775.00	-9.24	-2.39	9.54	194.50	107.0
8/24/95	0:00:00	11790.00	-2.93	-5.45	6.18	241.77	106.9
8/24/95	0:15:00	11805.00	-1.88	-7.05	7.29	255.10	107.4

Date	Time	t (min)	u (cm/sec)	v(cm/sec)	Speed(cm/sec)	Dir (deg)	Depth (cm)
8/24/95	0:30:00	11820.00	1.13	-7.50	7.58	278.61	107.0
8/24/95	0:45:00	11835.00	2.54	-8.54	8.91	286.60	107.1
8/24/95	1:00:01	11850.00	7.68	-9.55	12.26	308.83	107.0
8/24/95	1:15:00	11865.00	13.83	-13.64	19.43	315.41	106.5
8/24/95	1:30:00	11880.00	19.70	-12.52	23.34	327.57	107.2
8/24/95	1:45:00	11895.00	15.08	-9.67	17.92	327.34	106.5
8/24/95	2:00:00	11910.00	9.73	-7.90	12.54	320.95	106.5
8/24/95	2:15:00	11925.00	14.43	-7.34	16.19	333.05	106.5
8/24/95	2:30:00	11940.00	13.31	-19.27	23.42	304.65	106.0
8/24/95	2:45:00	11955.00	26.93	-20.07	33.59	323.31	105.7
8/24/95	3:00:00	11970.00	27.98	-16.62	32.55	329.30	105.7
8/24/95	3:15:01	11985.00	27.82	-34.62	44.41	308.79	105.5
8/24/95	3:30:00	12000.00	23.76	-23.69	33.55	315.09	105.5
8/24/95	3:45:00	12015.00	20.22	-21.00	29.15	313.93	105.8
8/24/95	4:00:00	12030.00	19.06	-17.86	26.12	316.87	105.7
8/24/95	4:15:00	12045.00	15.12	-13.08	19.99	319.15	105.7
8/24/95	4:30:00	12060.00	16.72	-9.22	19.10	331.14	105.9
8/24/95	4:45:00	12075.00	16.81	-7.94	18.59	334.73	105.7
8/24/95	5:00:00	12090.00	17.17	-10.83	20.30	327.77	106.0
8/24/95	5:15:00	12105.00	21.67	-12.96	25.25	329.13	105.5
8/24/95	5:30:00	12120.00	27.29	-14.81	31.05	331.52	105.7
8/24/95	5:45:00	12135.00	26.69	-13.24	29.80	333.62	105.4
8/24/95	6:00:00	12150.00	37.30	-20.32	42.48	331.43	105.4
8/24/95	6:15:00	12165.00	32.68	-16.38	36.56	333.39	105.4
8/24/95	6:30:00	12180.00	33.16	-16.06	36.85	334.16	105.5
8/24/95	6:45:00	12195.00	39.23	-19.71	43.91	333.33	105.4
8/24/95	7:00:00	12210.00	36.46	-17.90	40.62	333.86	105.4
8/24/95	7:15:00	12225.00	37.26	-20.28	42.42	331.45	105.5
8/24/95	7:30:00	12240.00	32.48	-17.30	36.80	331.97	105.9
8/24/95	7:45:00	12255.00	29.62	-17.34	34.33	329.66	105.4
8/24/95	8:00:00	12270.00	36.01	-18.06	40.29	333.37	105.5
8/24/95	8:15:00	12285.00	31.59	-17.82	36.27	330.58	105.5
8/24/95	8:30:00	12300.00	34.81	-19.43	39.87	330.84	105.5
8/24/95	8:45:00	12315.00	34.97	-16.82	38.81	334.32	105.5
8/24/95	9:00:00	12330.00	34.77	-17.38	38.88	333.45	104.9
8/24/95	9:15:00	12345.00	32.72	-13.24	35.30	337.98	105.0
8/24/95	9:30:00	12360.00	29.42	-16.14	33.56	331.26	105.5
8/24/95	9:45:00	12375.00	25.12	-12.64	28.12	333.30	105.5
8/24/95	10:00:00	12390.00	24.40	-14.45	28.36	329.37	105.5
8/24/95	10:15:00	12405.00	25.24	-16.54	30.18	326.77	105.8
8/24/95	10:30:00	12420.00	23.03	-13.81	26.86	329.06	105.7
8/24/95	10:45:00	12435.00	23.52	-13.40	27.07	330.34	105.7
8/24/95	11:00:00	12450.00	16.28	-15.25	22.31	316.88	105.4
8/24/95	11:15:01	12465.00	15.92	-10.99	19.35	325.40	107.4
8/24/95	11:30:00	12480.00	12.55	-10.03	16.07	321.39	107.6
8/24/95	11:45:00	12495.00	8.97	-8.82	12.58	315.51	107.6
8/24/95	12:00:00	12510.00	4.87	-7.25	8.73	303.93	107.6
8/24/95	12:15:00	12525.00	2.98	-5.93	6.64	296.73	107.7
8/24/95	12:30:00	12540.00	-3.57	-5.57	6.61	237.37	107.6

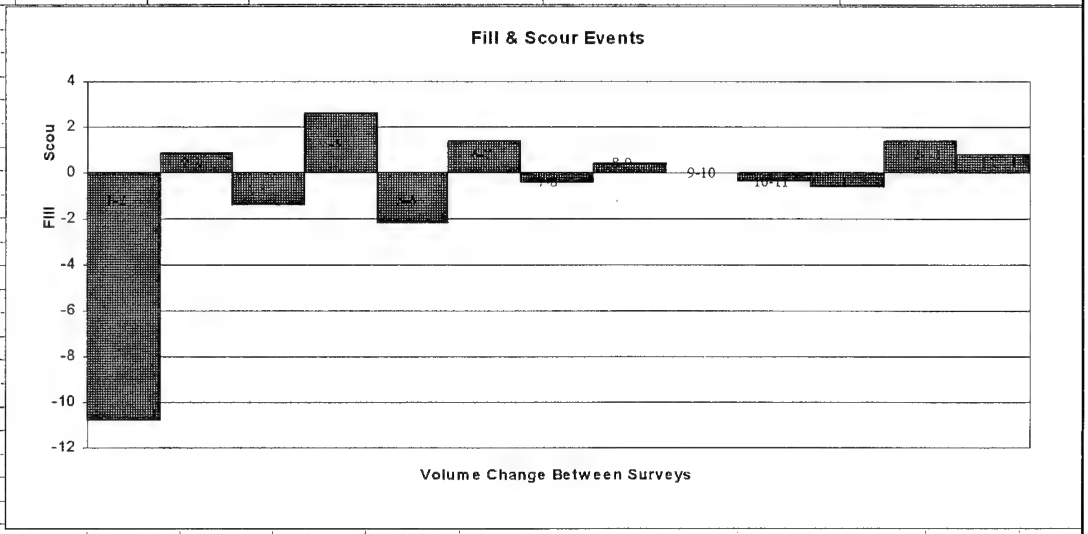
Appendix E

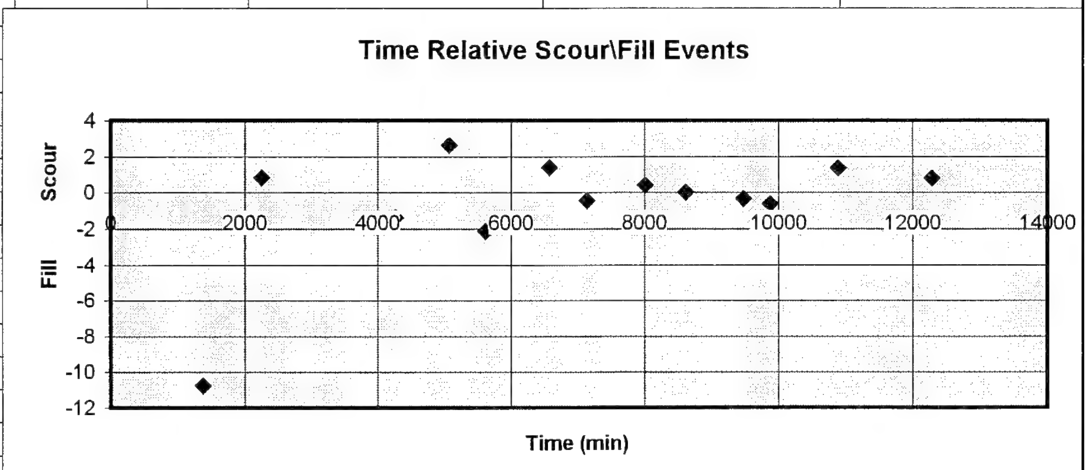
The following pages are the volumetric analysis sheets. The first two pages in this section are a summary of the volumetric changes that were pulled off the Surfer data sheets that follow.

Appendix E - Scour Fill Volume Summary

	'1-2				'7-8
	CUT & FILL VOLUMES				CUT & FILL VOLU
		Positive	0.048973		
		Negativ	10.8126		
		Cuts mi	-10.7637		
	'2-3				'8-9
	CUT & FILL VOLUMES				CUT & FILL VOLU
		Positive	1.09933		
		Negativ	0.273331		
		Cuts mi	0.825999		
	'3-4				'9-10
	CUT & FILL VOLUMES				CUT & FILL VOLU
		Positive	0.884876		
		Negativ	2.2741		
		Cuts mi	-1.38923		
	'4-5				'10-11
	CUT & FILL VOLUMES				CUT & FILL VOLU
		Positive	2.9682		
		Negativ	0.349941		
		Cuts mi	2.61826		
	'5-6				'11-12
	CUT & FILL VOLUMES				CUT & FILL VOLU
		Positive	0.755753		
		Negativ	2.91875		
		Cuts mi	-2.163		
	'6-7				'12-13
	CUT & FILL VOLUMES				CUT & FILL VOLU
		Positive	1.76766		
		Negativ	0.367602		
		Cuts mi	1.40005		
					'13-14
					CUT & FILL VOLU

	t(min)	Positive Volume [Cuts]:	Negative Volume [Fills]:	Cuts minus Fills:
'1-2	1375	0.048973	10.8126	-10.7637
'2-3	2260	1.09933	0.273331	0.825999
'3-4	4260	0.884876	2.2741	-1.38923
'4-5	5070	2.9682	0.349941	2.61826
'5-6	5610	0.755753	2.91875	-2.163
'6-7	6570	1.76766	0.367602	1.40005
'7-8	7140	0.772136	1.22298	-0.450846
'8-9	8010	1.22764	0.821454	0.406187
'9-10	8610	0.961787	0.948775	0.0130128
'10-11	9480	0.852061	1.19721	-0.345146
'11-12	9870	1.01698	1.64496	-0.627982
'12-13	10890	1.81172	0.4472	1.36452
'13-14	12280	1.65585	0.877692	0.778158





```
VOLUME COMPUTATIONS

UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ1B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.54746 to -0.511248
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ2B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.51807 to -0.437313
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       -10.7639
        Simpson's Rule: -10.7645
        Simpson's 3/8 Rule:     -10.7558

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 0.048973
        Negative Volume [Fills]:        10.8126
        Cuts minus Fills:       -10.7637
AREAS
        Positive Planar Area
        (Upper above Lower):    2.28109
        Negative Planar Area
        (Lower above Upper):    40.9717
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895
        Positive Surface Area
        (Upper above Lower):    2.28494
        Negative Surface Area
        (Lower above Upper):    42.2387
```

```
VOLUME COMPUTATIONS

UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ2B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.51807 to -0.437313
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ3B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.5223 to -0.496819
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       0.826015
        Simpson's Rule: 0.825457
        Simpson's 3/8 Rule:     0.826283

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 1.09933
        Negative Volume [Fills]:        0.273331
        Cuts minus Fills:       0.825999
AREAS
        Positive Planar Area
        (Upper above Lower):    34.5012
        Negative Planar Area
        (Lower above Upper):    8.75154
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895

        Positive Surface Area
        (Upper above Lower):    34.5431
        Negative Surface Area
        (Lower above Upper):    8.82582
```

```
VOLUME COMPUTATIONS

UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ3B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.5223 to -0.496819
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ4B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.55066 to -0.507828
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       -1.38882
        Simpson's Rule: -1.39295
        Simpson's 3/8 Rule:     -1.39521

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 0.884876
        Negative Volume [Fills]:        2.2741
        Cuts minus Fills:       -1.38923
AREAS
        Positive Planar Area
        (Upper above Lower):    11.7605
        Negative Planar Area
        (Lower above Upper):    31.4922
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895

        Positive Surface Area
        (Upper above Lower):    12.1757
        Negative Surface Area
        (Lower above Upper):    31.7775
```

VOLUME COMPUTATIONS

```
UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ4B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.55066 to -0.507828
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ5B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.54486 to -0.459804
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       2.61761
        Simpson's Rule: 2.62018
        Simpson's 3/8 Rule:     2.61845

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 2.9682
        Negative Volume [Fills]:        0.349941
        Cuts minus Fills:       2.61826
AREAS
        Positive Planar Area
        (Upper above Lower):    28.5667
        Negative Planar Area
        (Lower above Upper):    14.686
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895

        Positive Surface Area
        (Upper above Lower):    28.9631
        Negative Surface Area
        (Lower above Upper):    14.7978
```

VOLUME COMPUTATIONS

```
UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ5B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.54486 to -0.459804
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ6B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.52443 to -0.463716
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       -2.16266
        Simpson's Rule: -2.16451
        Simpson's 3/8 Rule:     -2.16432

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 0.755753
        Negative Volume [Fills]:        2.91875
        Cuts minus Fills:       -2.163
AREAS
        Positive Planar Area
        (Upper above Lower):    16.0057
        Negative Planar Area
        (Lower above Upper):    27.2471
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895

        Positive Surface Area
        (Upper above Lower):    16.1891
        Negative Surface Area
        (Lower above Upper):    27.6166
```

```
VOLUME COMPUTATIONS

UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ6B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.52443 to -0.463716
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ7B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.54532 to -0.474234
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       1.40016
        Simpson's Rule: 1.40236
        Simpson's 3/8 Rule:     1.39901

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 1.76766
        Negative Volume [Fills]:        0.367602
        Cuts minus Fills:       1.40005
AREAS
        Positive Planar Area
        (Upper above Lower):    27.4476
        Negative Planar Area
        (Lower above Upper):    15.8051
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895

        Positive Surface Area
        (Upper above Lower):    27.6642
        Negative Surface Area
        (Lower above Upper):    15.8874
```

```
VOLUME COMPUTATIONS

UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ7B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.54532 to -0.474234
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ8B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.51135 to -0.473142
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       -0.451167
        Simpson's Rule: -0.45328
        Simpson's 3/8 Rule:     -0.451151

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 0.772136
        Negative Volume [Fills]:        1.22298
        Cuts minus Fills:       -0.450846
AREAS
        Positive Planar Area
        (Upper above Lower):    17.1839
        Negative Planar Area
        (Lower above Upper):    26.0688
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895

        Positive Surface Area
        (Upper above Lower):    17.3122
        Negative Surface Area
        (Lower above Upper):    26.171
```

VOLUME COMPUTATIONS

```
UPPER SURFACE
        Grid File:       C:/DESTIN/SURFER~1/XYZ8B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:       50 cols by 50 rows
        Delta X:         0.134894
        Delta Y:         0.134894
        X-Range:         0 to 6.6098
        Y-Range:         0 to 6.6098
        Z-Range:         -1.51135 to -0.473142
LOWER SURFACE
        Grid File:       C:/DESTIN/SURFER~1/XYZ9B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:       50 cols by 50 rows
        Delta X:         0.134894
        Delta Y:         0.134894
        X-Range:         0 to 6.6098
        Y-Range:         0 to 6.6098
        Z-Range:         -1.53581 to -0.484208
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:        0.406601
        Simpson's Rule: 0.406623
        Simpson's 3/8 Rule:      0.405525


AREAS
        Positive Planar Area
        (Upper above Lower):     25.0575
        Negative Planar Area
        (Lower above Upper):     18.1952
        Blanked Planar Area:     0.436713
        Total Planar Area:       43.6895

        Positive Surface Area
        (Upper above Lower):     25.1897
        Negative Surface Area
        (Lower above Upper):     18.2617
```

```
VOLUME COMPUTATIONS

UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ9B.GRD
        Rows:   0 to 32766
        Cols:   0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.53581 to -0.484208
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ10B.GRD
        Rows:   0 to 32766
        Cols:   0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.51518 to -0.404706
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       0.0127671
        Simpson's Rule: 0.0135067
        Simpson's 3/8 Rule:     0.0118949

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 0.961787
        Negative Volume [Fills]:        0.948775
        Cuts minus Fills:       0.0130128
AREAS
        Positive Planar Area
        (Upper above Lower):    22.7957
        Negative Planar Area
        (Lower above Upper):    20.457
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895

        Positive Surface Area
        (Upper above Lower):    22.9136
        Negative Surface Area
        (Lower above Upper):    20.5499
```

```
VOLUME COMPUTATIONS

UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ10B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.51518 to -0.404706
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ11B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.54633 to -0.473534
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       -0.34503
        Simpson's Rule: -0.345119
        Simpson's 3/8 Rule:     -0.345719

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 0.852061
        Negative Volume [Fills]:        1.19721
        Cuts minus Fills:       -0.345146
AREAS
        Positive Planar Area
        (Upper above Lower):    22.5191
        Negative Planar Area
        (Lower above Upper):    20.7336
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895

        Positive Surface Area
        (Upper above Lower):    22.5878
        Negative Surface Area
        (Lower above Upper):    20.8239
```

```
VOLUME COMPUTATIONS

UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ11.GRD
        Rows:   0 to 32766
        Cols:   0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.54633 to -0.473534
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ12B.GRD
        Rows:   0 to 32766
        Cols:   0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.54388 to -0.40023
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       -0.62731
        Simpson's Rule: -0.628509
        Simpson's 3/8 Rule:     -0.629164

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 1.01698
        Negative Volume [Fills]:        1.64496
        Cuts minus Fills:       -0.627982
AREAS
        Positive Planar Area
        (Upper above Lower):    24.2414
        Negative Planar Area
        (Lower above Upper):    19.0113
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895

        Positive Surface Area
        (Upper above Lower):    24.3507
        Negative Surface Area
        (Lower above Upper):    19.202
```

```
VOLUME COMPUTATIONS

UPPER SURFACE
        Grid File:       C:/DESTIN/SURFER~1/XYZ12B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:       50 cols by 50 rows
        Delta X:         0.134894
        Delta Y:         0.134894
        X-Range:         0 to 6.6098
        Y-Range:         0 to 6.6098
        Z-Range:         -1.54388 to -0.40023
LOWER SURFACE
        Grid File:       C:/DESTIN/SURFER~1/XYZ13B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:       50 cols by 50 rows
        Delta X:         0.134894
        Delta Y:         0.134894
        X-Range:         0 to 6.6098
        Y-Range:         0 to 6.6098
        Z-Range:         -1.42896 to -0.484162
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:        1.36422
        Simpson's Rule: 1.36642
        Simpson's 3/8 Rule:      1.36548

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 1.81172
        Negative Volume [Fills]:        0.4472
        Cuts minus Fills:        1.36452
AREAS
        Positive Planar Area
        (Upper above Lower):     28.4464
        Negative Planar Area
        (Lower above Upper):     14.8064
        Blanked Planar Area:     0.436713
        Total Planar Area:       43.6895

        Positive Surface Area
        (Upper above Lower):     28.6358
        Negative Surface Area
        (Lower above Upper):     14.9028
```

```
VOLUME COMPUTATIONS

UPPER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ13B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.42896 to -0.484162
LOWER SURFACE
        Grid File:      C:/DESTIN/SURFER~1/XYZ14B.GRD
        Rows:    0 to 32766
        Cols:    0 to 32766
        Grid size as read:      50 cols by 50 rows
        Delta X:        0.134894
        Delta Y:        0.134894
        X-Range:        0 to 6.6098
        Y-Range:        0 to 6.6098
        Z-Range:        -1.54386 to -0.393859
VOLUMES
        Approximated Volume by
        Trapezoidal Rule:       0.777655
        Simpson's Rule: 0.777281
        Simpson's 3/8 Rule:     0.777344

CUT & FILL VOLUMES
        Positive Volume [Cuts]: 1.65585
        Negative Volume [Fills]:        0.877692
        Cuts minus Fills:       0.778158
AREAS
        Positive Planar Area
        (Upper above Lower):    23.3091
        Negative Planar Area
        (Lower above Upper):    19.9436
        Blanked Planar Area:    0.436713
        Total Planar Area:      43.6895

        Positive Surface Area
        (Upper above Lower):    23.4795
        Negative Surface Area
        (Lower above Upper):    20.0541
```

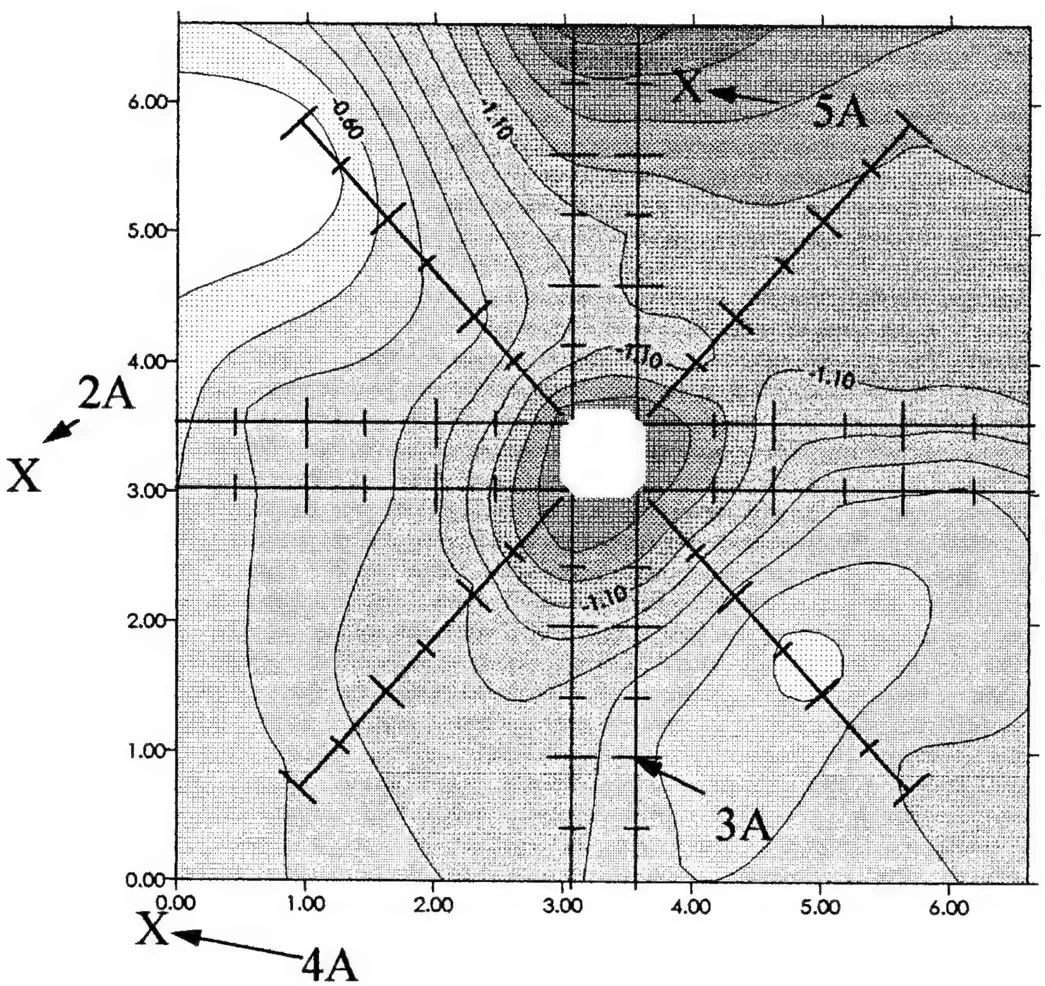
Appendix F

The following pages contain the Destin Sieve Analysis Data. The first page is a summary that document the location and sediment size. The following sheets are the actual Sieve Analysis for the individual sand samples.

Destin Sieve Analysis Summary

Sample:	D_{50}:
1A - From borrow area	.27 mm
2A	.275mm
3A	.28 mm
4A	.29 mm
5A	.30 mm

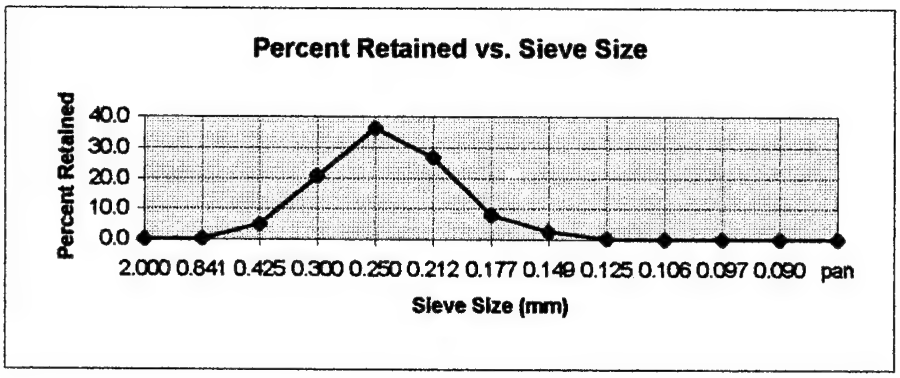
Relative location to test pile:

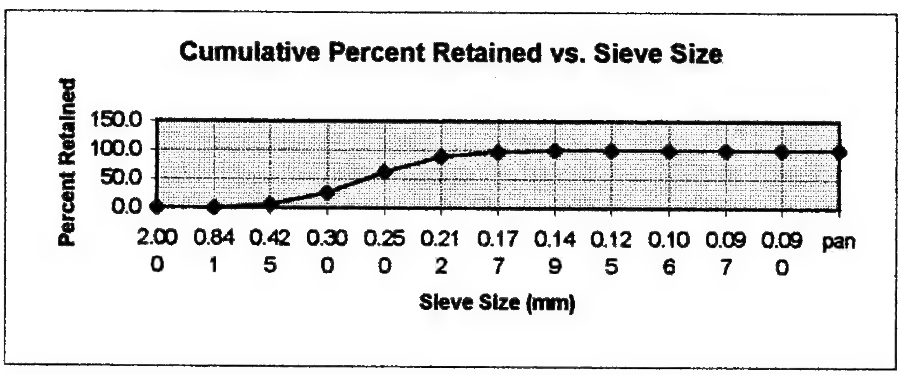


Destin August 1995 Sieve Analysis

Sample:	Destin Scour #1A		Wt. Dry Soil:	130.2
Date:	8/22/95		Wt. After Test:	130.26
D_{50} =	.27mm		Sieve loss:	-0.064

Sieve # U.S Standard	Sieve Opening mm	Weight of Soil (g) Ind.	Weight of Soil (g) Cum.	Percent Ind.	Percent Cum.	Percent Finer
10	2.000	0.1	0.1	0.1	0.1	99.9
20	0.841	0.3	0.4	0.2	0.3	99.7
40	0.425	6.3	6.7	4.8	5.1	94.9
50	0.300	26.9	33.6	20.7	25.8	74.2
60	0.250	47.4	81	36.4	62.2	37.8
70	0.212	35.1	116.1	27.0	89.2	10.8
80	0.177	10.4	126.5	8.0	97.1	2.9
100	0.149	3.3	129.8	2.5	99.7	0.3
120	0.125	0.3	130.1	0.2	99.9	0.1
140	0.106	0.07	130.17	0.1	100.0	0.0
160	0.097	0.042	130.21	0.0	100.0	0.0
170	0.090	0.012	130.22	0.0	100.0	0.0
pan	pan	0.04	130.26	0.0	100.0	*

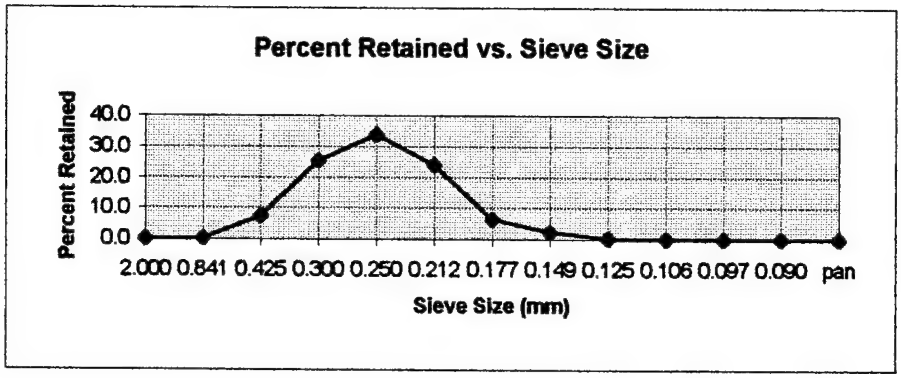


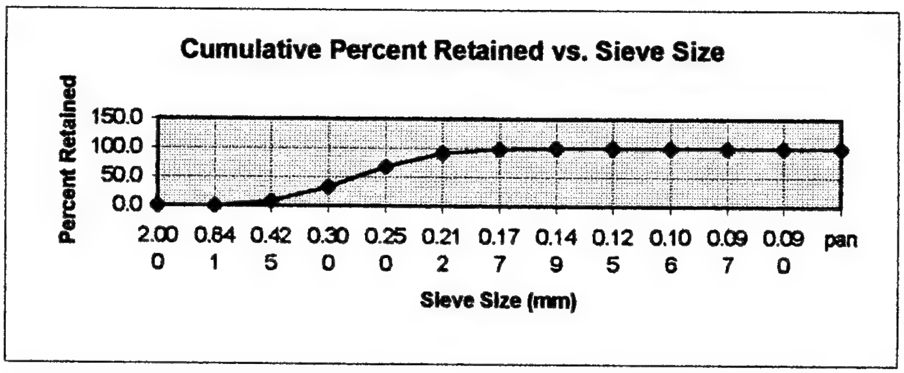


Destin August 1995 Sieve Analysis

Sample:	Destin Scour #2A		Wt. Dry Soil:	132.8
Date:	8/22/95		Wt. After Test:	132.61
D_{50} =	.275mm		Sieve loss:	0.192

Sieve # U.S Standard	Sieve Opening mm	Weight of Soil (g) Ind.	Cum.	Percent Ind.	Percent Cum.	Percent Finer
10	2.000	0.017	0.017	0.0	0.0	100.0
20	0.841	0.4	0.417	0.3	0.3	99.7
40	0.425	9.9	10.317	7.5	7.8	92.2
50	0.300	33.6	43.917	25.3	33.1	66.9
60	0.250	45	88.917	33.9	67.1	32.9
70	0.212	31.9	120.82	24.1	91.1	8.9
80	0.177	8.5	129.32	6.4	97.5	2.5
100	0.149	2.9	132.22	2.2	99.7	0.3
120	0.125	0.3	132.52	0.2	99.9	0.1
140	0.106	0.048	132.57	0.0	100.0	0.0
160	0.097	0.013	132.58	0.0	100.0	0.0
170	0.090	0.009	132.59	0.0	100.0	0.0
pan	pan	0.021	132.61	0.0	100.0	*

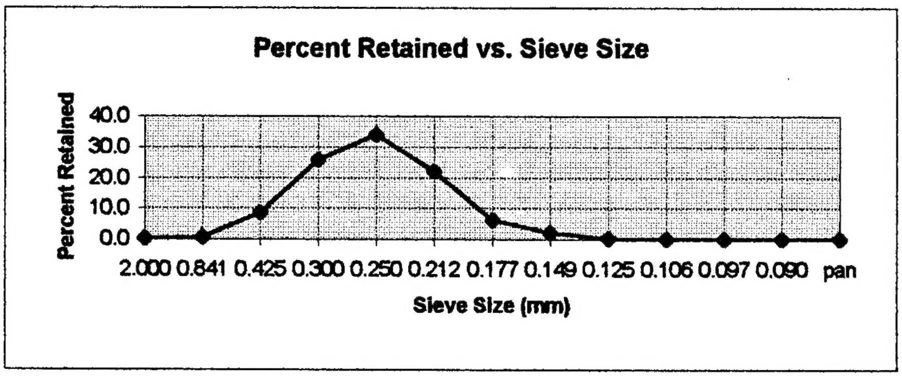


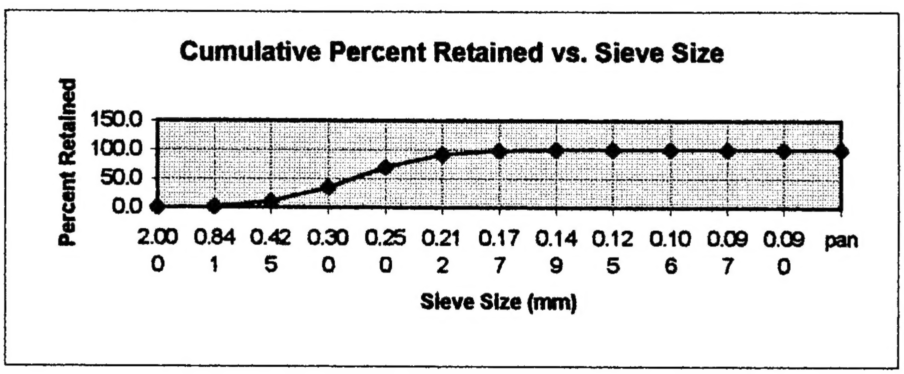


Destin August 1995 Sieve Analysis

Sample:	Destin Scour #3A	Wt. Dry Soil:	133.2
Date:	8/22/95	Wt. After Test:	133.25
D_{50} =	2.8mm	Sieve loss:	-0.047

Sieve # U.S Standard	Sieve Opening mm	Weight of Soil (g) Ind.	Weight of Soil (g) Cum.	Percent Ind.	Percent Cum.	Percent Finer
10	2.000	0.3	0.3	0.2	0.2	99.8
20	0.841	0.7	1	0.5	0.8	99.2
40	0.425	11.4	12.4	8.6	9.3	90.7
50	0.300	34.3	46.7	25.7	35.1	64.9
60	0.250	45.5	92.2	34.2	69.2	30.8
70	0.212	29.6	121.8	22.2	91.4	8.6
80	0.177	8.3	130.1	6.2	97.7	2.3
100	0.149	2.6	132.7	2.0	99.6	0.4
120	0.125	0.4	133.1	0.3	99.9	0.1
140	0.106	0.1	133.2	0.1	100.0	0.0
160	0.097	0.019	133.22	0.0	100.0	0.0
170	0.090	0.01	133.23	0.0	100.0	0.0
pan	pan	0.018	133.25	0.0	100.0	*

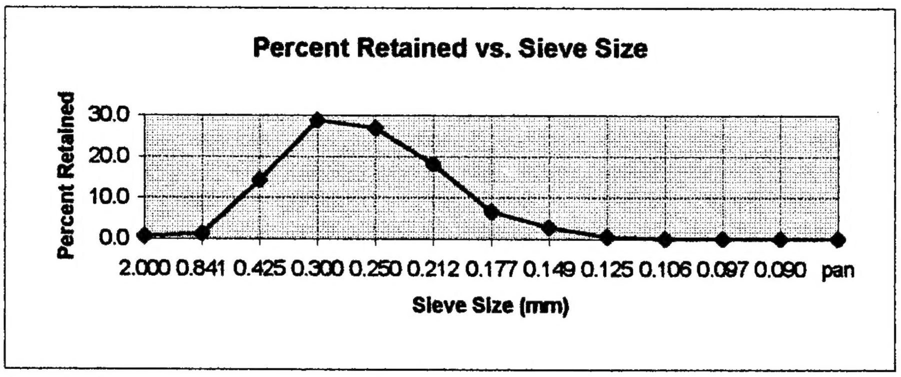


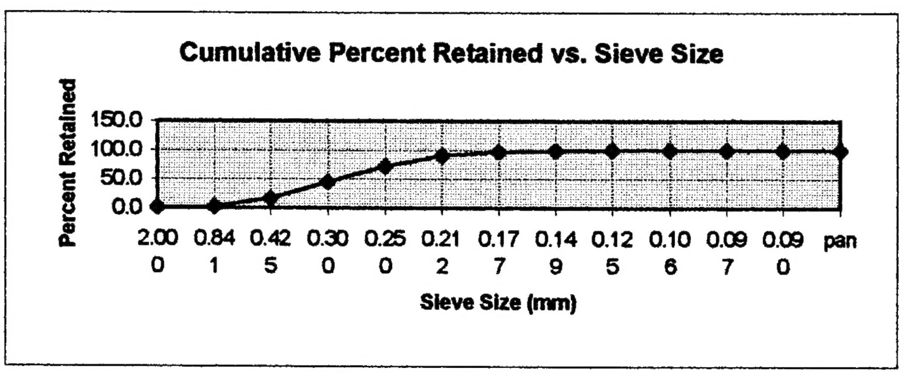


Destin August 1995 Sieve Analysis

Sample:	Destin Scour #4A	Wt. Dry Soil:	136.3
Date:	8/22/95	Wt. After Test:	135.52
D_{50} =	2.9mm	Sieve loss:	0.781

Sieve # U.S Standard	Sieve Opening mm	Weight of Soil (g) Ind.	Weight of Soil (g) Cum.	Percent Ind.	Percent Cum.	Percent Finer
10	2.000	0.8	0.8	0.6	0.6	99.4
20	0.841	1.7	2.5	1.3	1.8	98.2
40	0.425	19.4	21.9	14.3	16.2	83.8
50	0.300	38.9	60.8	28.7	44.9	55.1
60	0.250	36.5	97.3	26.9	71.8	28.2
70	0.212	24.6	121.9	18.2	90.0	10.0
80	0.177	9	130.9	6.6	96.6	3.4
100	0.149	3.7	134.6	2.7	99.4	0.6
120	0.125	0.7	135.3	0.5	99.9	0.1
140	0.106	0.1	135.4	0.1	99.9	0.1
160	0.097	0.042	135.44	0.0	100.0	0.0
170	0.090	0.026	135.47	0.0	100.0	0.0
pan	pan	0.051	135.52	0.0	100.0	*

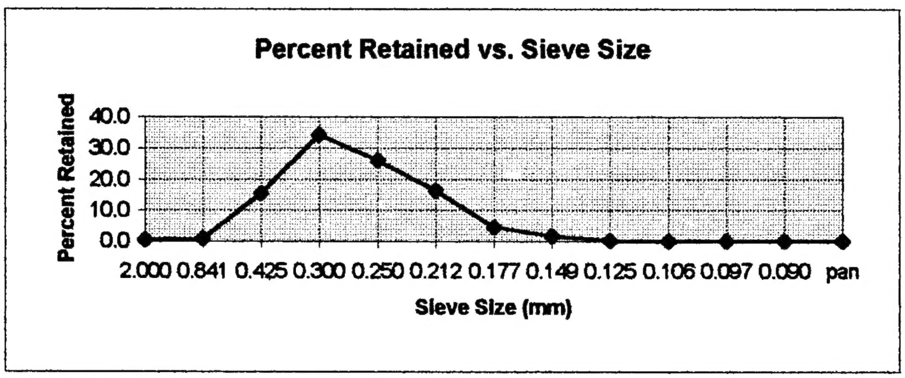


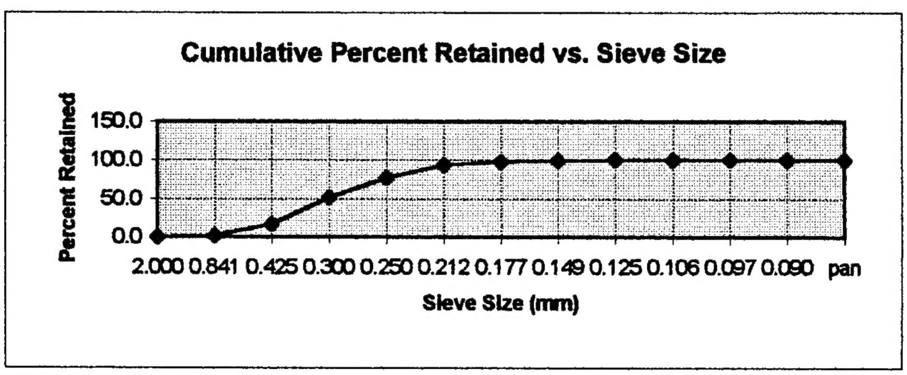


Destin August 1995 Sieve Analysis

Sample:	Destin Scour #5A	Wt. Dry Soil:	136.3
Date:	8/22/95	Wt. After Test:	131.55
D_{50} =	.3mm	Sieve loss:	4.752

Sieve # U.S Standard	Sieve Opening mm	Weight of Soil (g) Ind.	Cum.	Percent Ind.	Percent Cum.	Percent Finer
10	2.000	0.5	0.5	0.4	0.4	99.6
20	0.841	1.2	1.7	0.9	1.3	98.7
40	0.425	20.4	22.1	15.5	16.8	83.2
50	0.300	45	67.1	34.2	51.0	49.0
60	0.250	34.3	101.4	26.1	77.1	22.9
70	0.212	21.5	122.9	16.3	93.4	6.6
80	0.177	6	128.9	4.6	98.0	2.0
100	0.149	2.1	131	1.6	99.6	0.4
120	0.125	0.4	131.4	0.3	99.9	0.1
140	0.106	0.1	131.5	0.1	100.0	0.0
160	0.097	0.017	131.52	0.0	100.0	0.0
170	0.090	0.009	131.53	0.0	100.0	0.0
pan	pan	0.022	131.55	0.0	100.0	*





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